Iron and Steel Engineer

Established 1907 as Proceedings of A. I. & S. E. E.

J. F. KELLY, *Editor*

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Entered as second-class matter January 25th, 1924, at Pittsburgh, Pa., under the Act of March 3rd, 1879.
Subscription Price $5.00 per year. Single Copy 50c.

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EDITORIAL

Twenty-Sixth Annual Convention and Exposition

The Convention is over, the Exposition is a matter of history, both of these events, held in Buffalo, June 16th to 20th, 1930, are firmly fixed in the minds of the Steel Plants, as one of the successful outstanding engineering efforts of the year.

Eighty-five percent of the Steel Tonnage in America was represented through Vice Presidents, Managers, Electrical, Combustion, Mechanical, Safety Engineers, Operating Superintendents, Master Mechanics, and even the men, who stand before the furnace, the men who roll the metal, the men who operate the hundred and one mechanical and electrical devices, which produces our enormous tonnages.

A criterion of the interest displayed by the representatives of the Iron and Steel Plants would be one of the days, when three engineering divisions, drew at their various technical sessions an attendance of one thousand, all of which were interested in the problems confronting the Industry. This is without a doubt, an indication that the Association of Iron and Steel Electrical Engineers are rendering a real engineering service to the Iron and Steel Industry, in providing programs which has to do with the administration, operation and maintenance of Steel Plants.

The Iron & Steel Engineer will carry in its editorial columns, the opinions expressed by the Steel Mill Representatives on the subjects discussed at the Convention and these opinions represent the results otbained in the field of operation. These opinions and expressions will cover Rolling Mills, Open Hearths, Heating Furnaces, The Use of Mixed Gases, Shop Practices, Anti-Friction Bearings for Roll Necks, Illumination of Steel Plants, E. O. T. Cranes, Motors, Safe Practices in Steel Plants, Electrically Operated Skip Hoists, Galvanizing, Methods of Drawing Rods, and the Latest Developments in Wire Drawing Machinery. All of this data and information will make valuable additions to the engineering transactions of the A. I. & S. E. E.

The Inspection Trip to the Steel Company of Canada by the Combustion Engineering Division was very successful and was well attended. One of the interesting features of this trip was the mixed gas installations. The Steel Company of Canada is one of the Pioneers in this particular, and is to be congratulated on their foresight and courage to advance the art of using mixed gases in the many applications now in use at their plant.

The Inspection Trip to the Lackawanna Plant of the Bethlehem Steel Company was attended by four hundred interested engineers and executives. Promptly at nine-thirty, Friday, June 20th, fourteen busses left the hotel. The Inspection party was met by Mr. Timothy Burns, General Manager and all of his superintendents. Practically every department in the plant was thrown open to the visitors and one of the interesting features was the structural mill, known as the "Grey Mill".

At one o'clock, the party moved to the Main Office and was served with a very elaborate luncheon, Mr. Burns was the host.

At two o'clock the party started through the lower end of the plant and the inspection ended at the Main Sub-station.

The Lackawanna Plant is one of the most modern plants in the United States, the electric installations particularly.

The Association, at this time, wishes to extend to all of the executives of the Lackawanna Plant of the Bethlehem Steel Company their sincerest appreciation for the many favors extended to them while on their visit to Buffalo.

To the Manufacturers, who made the exposition possible, the Association and the Steel Industry wishes to congratulate them on the magnificent demonstration they made of the apparatus used in the Iron and Steel Plants. The thousands, who inspected and examined the various exhibits, expressed also their appreciation for being allowed an opportunity to meet the manufacturers on a common ground and discuss their mutual problems.

To the Members of the A. I. & S. E. E., to the Steel Mill Executives who were our guests, to the visitors at the Exposition, the Association's Executive Officers wishes to extend to all of you, their keenest and deepest appreciation in helping to make our 26th ANNUAL CONVENTION AND EXPOSITION the greatest, engineering event for the year 1930.

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Standardization of Steel Mill Magnetic Control Diagrams

Some of the most interesting romances of modern industries are the great developments made in the use of electricity in our steel mills. Application of electricity has advanced hand in hand with the developments in the manufacturing of steel and, undoubtedly, has made possible many of our present economic steel mill practices.

One of the greatest advantages of the application of the electric motors accrues from the ease, flexibility and accuracy with which the drive may be controlled.

In the period of keen competition any change in conditions or any develoment which effects cost is naturally of vital importance. That may be one of the main reasons for the present-day trend toward greater use of automatic control.

Installation of automatic control in most cases reduces the labor cost and it removes from the operator the repetitive duties which have to be executed thoughtlessly. By doing this automatic control improves the work of the man by giving him more time to think and less chance to become tired.

While great strides have been made in the standardization of steel mill auxiliary motors, the control problem has held a secondary place with the result that each control manufacturer offers control varying in many details from any other manufacturers product or layout.

Present lack of control standardization makes control diagrams very difficult for an average electrical man to understand, because each manufacturers methods vary so greatly.

In our steel mills today, a relatively small number of electrical men are sufficiently familiar with magnetic control diagrams to be able to read any diagram placed before them. As a result, in the great majority of plants usually only a few repairmen are qualified to work on magnetic control boards and, even they are generally familiar only with some particular make of type of control. When they are called to work on a different type of control it results in slow progress, because the man has not only to familiarize himself with the new diagram and the arrangement of the units, but he also has to find out the meaning of the symbols used. Even though a steel plant may want to standardize on one manufacturers equipment there is always a certain amount of other makes of apparatus that get in around the mills on more or less important applications. This condition applies to controllers probably more than any class of electrical equipment.

There is a long felt want and it would be of great assistance to the electrical men working on magnetic controllers in our steel mills and of material saving in time and money to these mills, if the various control manufacturers would standardize on the nomenclature, symbols for wiring diagrams, schematic diagrams and the general arangement of apparatus on the control board.

As an illustration of the present-day practice let us take a reversing controller and compare the diagrams of some of the manufacturers who build steel mill auxiliary control equipment. It is interesting to note that, due to lack of standardization, numbering of wiring varies many ways. Some show the sequence of contactors and scheme of main connections, while others make up a separate diagram showing the line diagram.

The forward and reversing contactors are designated by some manufacturers as "FR", while others use "1F" and "2F", "1B" and "2B", or "1F and 2F —1R and 2R" and still others call them "#1 and #4 —#2 and #3".

The accelerating contactors likewise are known as "R2-R3", "2R-3R", "1A-2A" or "#11-#12", etc.

To further illustrate our present lack of standardization, certain contactor is now being spoken of as

1. Line Contactor, or
2. Circuit breaker contactor, or
3. Negative line contactor, or
4. Contactor for opening the side of the line opposite the reversing contactors.

On the wiring diagrams some of the control manufacturers represent this contactor by the letter "M", while others call it the "CB" or "#5" contactor.

Some of the larger steel plants, who maintain engineering and drafting departments, make up their own standardized diagrams to meet their plant requirements. In a plant using many hundred magnetic controllers, the cost of making these diagrams is considerable, even though many of the panels are duplicates. In smaller plants, which are without facilities for this kind of work, it is almost impossible to get this redrawing of diagrams taken care of. Since the manufacturer has to make a diagram for each different control panel he supplies, the expense of making these diagrams standard in regard to symbols and general arrangement and to include all the necessary information would be small indeed and would save the duplication of this work in the steel plant, as well as the expense involved.

Operation delays can be reduced if the maintenance electrician is entirely familiar with the control for which he is responsible. If he has ready access to the blueprints of these panels and is taught to study same and use them in a case of trouble, valuable time may often be saved.

If we expect our maintenance electricians to study these diagrams we must not only make them as simple as possible, but have them all made in standard form, so that they are easily understood and can be readily followed.

Fuels

By M. J. CONWAY*

OPEN HEARTH PRACTICE FOR THE OPEN HEARTH EMPLOYEE

LESSON NO. 3

The following lecture is one of a series which will appear in the Iron and Steel Engineer and was prepared by Mr. M. J. Conway, Combustion Engineer of the Lukens Steel Company at Coatesville, Pa. These lectures were presented before the employees of the Open Hearth Department of the Lukens Steel Company and were illustrated by a model of an Open Hearth Furnace.

It was felt that the preparation and presentation of a series of lectures of this character would bring the employee into closer touch with the design, operation and maintenance of the furnace. At the close of each lecture, the employees were invited to question the various points touched on and these questions and answers will appear at the end of the series.

The Lukens Steel Company is to be congratulated on this particular program of education to the employee.

When these lessons have been printed in the Iron and Steel Engineer the entire course will be reprinted and bound under one cover and will be available to all interested parties at a slight cost.

It is a remarkable fact, that the open hearth steel process has not undergone any fundamental modifications since its introduction. The economy of the open hearth steel process has undoubtedly been increased by improved working methods. On the other hand, the calorific efficiency of the furnaces has not been essentially improved. For each 100 lbs. of fuel used, only about 30 pounds are utilized in the actual manufacture of steel the remaining 70 pounds being a total loss. If we assume that the total ingot production in the United States in the year 1929 is to be 50,000,000 tons and that the coal equivalent to make the tonnage is 15,000,000 tons, only 4,500,000 tons of fuel will be used in making the ingots produced and 10,500,000 tons of fuel will be lost as being wasted.

The open hearth furnace, regarded as an apparatus for the effcient utilization of gaseous or liquid fuels can hardly be regarded as a success and it is not difficult to understand the reason for many of the attempts which have been made to improve its efficiency. Speaking generally, little progress has been made, since the first introduction of Siemens, of a furnace for the manufacture of molten steel. It is by no means beyond the powers of steel plant engineers to design a combination of gas and air ports to produce a high state of efficiency and combustion. The chief difficulty arises from the fact that with the regenerative system at present in operation, a furnace block designed to give the highest efficiency in combustion is not capable of dealing with the products of combustion at the outgoing end. Attempts have been made to overcome this difficulty with more or less success, but it is safe to assume that, at the present time, the large majority of open hearth furnaces in this country are of the character that have become familiar to us during the past few years.

The problem of producing a ton of steel, with the lowest possible expenditure of fuel, either gaseous or liquid, is one which divides itself into three subdivisions, viz:

(1) Quality of fuel
(2) Furnace output
(3) Efficient Utilization

* Combustion Engr., Lukens Steel Co., Coatesville, Pa.

The chemistry of combustion as applied to open hearth furnace practice is elementary, but for a proper comprehension of the subject it seems advisable in include a brief consideration of the general principles involved, together with data covering the combining qualities of the constituents of the fuel ordinarily encountered in open hearth practice with special reference to oil.

Combustion is the phenomenon resulting from any chemical combination evolving heat. Oxygen is the sole supporter of combustion, and a combustible therefore may be defined as a substance capable of combining with oxygen to produce heat. The speed of combustion depends upon the affinity of the combustible element for oxygen and to a lesser degree upon the conditions under which combustion takes place. This speed may vary from the very slow, as in the case of rust formation to the instantaneous, as in the explosion of confined powder.

The speed of combustion is as stated dependent upon the affinity of the combustible substance for oxygen and the conditions under which the combustion takes place. The chief of these conditions is that of temperature, and this factor must be considered before discussing the effect of excess or insufficient oxygen on combustion.

The mere fact that a combustible substance is brought into the presence of oxygen does not of necessity cause combustion to follow. Every combustible substance has a temperature called its ignition temperature, to which it must be brought before it will unite in chemical combination with oxygen and below which actual combustion will not take place; and this ignition temperature must exist with oxygen present or there will be no combustion.

From the standpoint of heat production for steel melting operations, combustion may be defined as the rapid combination of the elements of fuel with oxygen, while in this sense the term combustible implies the capacity of the fuel element, for combining rapidly with oxygen to produce heat.

Combustion is said to be complete when the combustible elements and compounds have united with all the oxygen, with which they are capable of entering into combination.

For the commercial production of heat it is essential that the combustible elements have a strong and

ready affinity for oxygen. Carbon and hydrogen which are by far the most important of combustible elements encountered in the common fuels meet this requirement admirably. These occur either in the free or combined state in all fuels, liquid, solid and gaseous.

This brings us to the point where we can consider the fuel we are now using, for fuel oil is rich in carbon and hydrogen.

The indefinite term fuel oil is employed broadly for the description of any product of petroleum which may be used for the production of heat, ranging from the distillate series down to and including any product which can be made liquid by steam heat and for which no better market outlet can be obtained. Generally speaking, there is no fixed specification for fuel oil, for industrial purposes, each user being guided by his own particular needs and facilities; it must not however, contain naphtha, and many consumers require that it be of such a consistency that it can be pumped through pipes and burners cold.

The two important physical characteristics by which fuel oil is judged are its specific gravity and viscosity.

The gravity or weight of fuel oil is usually expressed in degrees Baume, 10°Bé being the weight of water. The higher the degree Bé the lighter the fuel oil compared with the weight of water.

The viscosity of a fuel oil relates to its fluidity and is measured by passing a standard quantity of oil through a standard orifice at a constant standard temperature. The time taken for the oil to flow through the orifice is expressed in seconds viscosity. Thus it takes a longer time for a thick oil to flow through the orifice than a thin oil, therefore, the lower the viscosity the thinner the oil.

Viscosity readings are necessary to ascertain the temperature the oil must be heated to before atomization, as by heating to the correct temperature thick oil becomes fluid and can be readily atomized.

The chief chemical features with the exception of the sulphur content which is usually below 1.0 per cent, is the fuel value, or heat value of the fuel. This is expressed in B.t.u. per pound or per gallon, and means British Thermal Unit, this thermal unit is a standard unit throughout the world being the amount of heat required to raise the temperature of one pound of water one degree Fahr. The B.t.u. value of fuel oil varies between 135,000 and 150,000 B.t.u. per gallon.

Fuel oil to be used economically must be correctly atomized, which means that the oil at the point of atomization, which is usually the burner must have the right viscosity, and as viscosity is a function of temperature the fuel oil system should be so designed that the proper oil temperature can be maintained at all rates of flow. A circulating system so designed that the foregoing points are well taken care of will handle almost any kind of fuel oil or tar that it is called upon to handle.

Fuel oil is usually purchased by the gallon and for that reason the lower Baume or heavier the oil the greater the B.t.u. content per gallon, but these heavier oils are lower in B.t.u. value per pound while the lighter oils have a greater B.t.u. value per pound but lower B.t.u. per gallon. Therefore it is economical to purchase the heavy oils, everything else being considered, because of their greater thermal value per gallon.

Some of the advantages to be obtained by the use of liquid fuels are as follows: It does not deteriorate or lose its fuel value in storage, it is easy to store and easy to convey to the point of consumption.

It burns with a very high flame temperature but on account of ready flame direction it permits greater refractory life and simpler furnace design. Checkers remain clean longer with fuel oil than with producer gas.

Furnace temperature regulation is not affected by events beyond the control of the operator such as occur in the gas making process.

Due to the fact that liquid fuel can be metered, individual furnace performance can be readily measured thereby allowing the executive to compare the efficiency of his furnace operators.

As previously explained, combustion is supported by oxygen and this oxygen is of course supplied by air. Theoretically, it requires 14.03 lbs. of air to burn one pound of oil of the composition we are now using, or 1504 cubic feet of air at 60° F. to burn one gallon of oil and as our average oil consumption per furnace per hour is around 250 gallons, it requires nearly 14.5 tons or 376,000 cubic feet of air to run the furnace one hour.

Fuel oil must be correctly atomized to be economically used. The pressure required to effect this atomization depends on the type and design of the burner and size of the outlet orifice, but with every type of burner an increase in pressure is necessary to atomize an increased quantity of oil.

The heating value of the gas formed through the atomization of fuel oil is very high. Values of 2,000 B.t.u. per cubic foot and higher are easily obtained and for this reason the flame should be properly directed and intimately mixed with air to obtain the full heating value.

Good practice in the atomization of fuel oil requires an average of 0.3 pounds of steam per pound of oil burned.

One pound of fuel oil requires 14 pounds or 183 cubic feet of air for complete combustion, 205 cubic feet is considered good practice.

The stack gases from an oil fired furnace for good efficiency should not contain less than 13% of carbon dioxide.

The temperature of an oil flame with complete combustion and without an excess of air is about 3750° F.

Due to the fact that fuel oil is so high in heat value a small quantity wasted is a big loss in heat units as compared with other fuels.

Some of the causes for high fuel oil consumption are as follows:

1—Lack of draught.
2—Excess draught.
3—Putting heats on pig.
4—Not watching charge to keep away from high and low melts.
5—Too much or not enough air.
6—Leaving heats lay when ready to work, or waiting bath to open up after heat is clear.
7—Oring heats too close and cold.
8—Bad burner tips.

9—Bad handling of burners as to elevation and correct placement.
10—Not knowing furnace power.
11—Taking too long to melt down.
12—Excess melting down.
13—Not fixing bottoms correctly.
14—Excess steam.
15—Lack of sufficient steam.
16—Improper charging of limestone and scrap, according to working of furnace.
17—Keeping metal too hot when melting high—Pulling bottoms causing loss of fuel replacing same.
18—Delays—caused by broken pipe on doors and frames.
19—Delays—caused by not engineering charges.
20—Phosphorus delays—caused by not working heat properly.
21—Leaving up—on account of changing turns.
22—Not keeping up bridge walls.
23—Charging too many furnaces at one time.
24—Turning oil on burners ahead of the steam when reversing.
25—Keeping oil on furnace while waiting on start, instead of dampering furnace down.
26—Low tonnage—due to light weight, low bottoms, holes in bottom, cold heats.
27—Wet steam.
28—Cold oil.
29—Irregular reversing.
30—Not watching tap holes to prevent delays on same.
31—Not preventing delays on ore, dolomite, spar and pig by having supply of same on floor at all times.
32—Not preventing excessive delays on bad bottoms.
33—Not cleaning all scrap off buggies to help prevent wrecks and broken engines which cause delays, high fuel consumption and lost tonnage, also light charges.
34—Not shutting tap holes properly and being prepared for hard taps by having oxygen tank and pipe ready.
35—Not getting tests to laboratory for preliminary analysis in plenty of time.
36—Not keeping the stock yard lined up as to approximate tapping time.
37—Not keeping the Pit Foreman informed of the progress of the heat, to prevent unnecessary delay.
38—Not keeping ends of the furnace bottom high to obtain proper draining of the furnace when tapping, to insure dry bottoms and maximum production.
39—Last but not least in importance is fuel lost due to air leaks around the furnace flues, checker chambers and valves. This air infiltration acts as ballast by robbing the furnace of heat carried out in the waste gases. If the furnace man cannot stop the leaks around his furnace he should report them to his melter so that this waste can be plugged.

Just a word on checkers before closing: The period between reversals has a direct bearing upon the design of the checkers in two important particulars; the heating and cooling time determines the weight of checker brick required and the thickness of the brick composing it. There is a limit to the quantity of heat which may be absorbed and given out by the brick-work. The practical limit is reached when the entire mass of brickwork is raised to a temperature at which heating gases pass through the checker with a very slight or no drop in temperature. The economical limit is reached when the heating gases leave the checker work at such a temperature that during the period when the checkers giving up heat the brickwork temperature does not drop below the initial temperature of the incoming gases,. plus the temperature differential necessary for heat transfer.

The **most important variable,** the period between reversals, is beyond the control of the furnace designer.

Quick reversals are necessary at certain stages of the operation, but it is certainly desirable that the work should be divided, as nearly as possible, between the two ends of the furnace. When the time factor depends entirely upon the human element it requires careful supervision to avoid considerable irregularity in operation, at the same time melt variations will prevent, automatically timed reversals, except during certain stages of the heat. We cannot over emphasize the necessity of your watching reversals carefully so that a complete balance is maintained between both ends of the furnace. The checkers are your heat storage or flywheel and by careful manipulation of this heat storage you can make most of the grades in high gear, in addition, you will be able to level up the hills and valleys in the fuel consumption.

IGNITION TEMPERATURES

Combustible Substance	Molecular Symbol	Ignition Temp. Degrees Fahr.
Sulphur	S_2	470
Fixed Carbon— Bituminous Coal	.....	766
Fixed Carbon— Semi-Bituminous Coal	.....	870
Anthracite	.....	925
Acetylene	C_2H_2	900
Ethane	C_2H_6	1000
Ethylene	C_2H_4	1022
Hydrogen	H_2	1130
Methane	CH_4	1202
Carbon Monoxide	CO	1210

OIL

Given an oil having an ultimate analysis as follows:

	Per Cent
Carbon	84.00
Hydrogen	12.70
Oxygen	1.20
Sulphur	.40
Nitrogen	1.70
	100.00

with perfect combustion the oxygen and air required per pound of oil, and the products of combustion will be as follows:

Weight Per Pound Oil Pounds	Required-Pounds O_2	Air	Products of Combustion-Pounds per Pound of Oil CO_2	O_2	N_2	H_2O	SO_2
C .8400	2.240	9.667	3.080		7.437		
H_2 .1270	1.016	4.389			3.373	1.143	
C_2 .0120				.012			
S .0040	.004	.017			.013		.008
N .0170					.017		
	3.260	14.083	3.080	.012	10.840	1.143	.008
O_2 in oil	.012	.052*		.012	.040*		
	3.248	14.031	3.080	.000	10.800	1.143	.008
SO_2 and CO_2			.008				.008
	3.248	14.031	3.088	.000	10,800	1.143	.000

* Air and N_2 equivalents of O_2 in oil.

VOLUME AND WEIGHT OF AIR AT ATMOSPHERIC PRESSURE

Temp. Degrees Fahrenheit	Volume in Cubic Feet per Pound	Weight of One Cubic Foot in Pounds	Temp. Degrees Fahrenheit	Volume in Cubic Feet per Pound	Weight of One Cubic Foot in Pounds
32	12,390	.080710	300	19,143	.052238
60	13,095	.076365	400	21,663	.046162
100	14,103	.070907	500	24,184	.041350
150	15,363	.065092	600	26,704	.037448
200	16,623	.060158	700	29,224	.034219
250	17,883	.055919	800	31,744	.031502

L. W. EGAN,
Died, May 2nd, 1930.

L. W. Egan, Engineering Sales Representative of the Clark Controller Company, passed away, Friday, May 2nd., 1930, after an illness of approximately two weeks.

Mr. Egan was connected with the Clark Controller Company since 1925 and had a long and varied career in the Iron and Steel Industry; having first been associated with the Hanna interests at Ashtabula Harbor, Ohio; then with the Pittsburgh Crucible Steel Company at Midland, Pa. Later he was associated with the American Steel Foundries Co., at Chicago, Ill., and then with the Ohio Steel Foundry at Lima, Ohio.

Mr. Egan was exceedingly active in the affairs of the Association of Iron and Steel Electrical Engineers, serving as Secretary of the Cleveland District Section and then as Chairman. He also served on many National Committees of this Society. His technical contributions to the transactions of this Society were many; among them being articles in connection with Electric Furnace Practices, Modern Practices in Foundries, Electric Overhead Traveling Crane Specifications and Purchased Power. "Len," as he was popularly known, was a keen student of all electrical activities, particularly the development of electrical practices in the Iron and Steel Industry. He had a legion of friends throughout the United States. The Association of Iron and Steel Electrical Engineers feel they have lost a warm supporter and a friend.

Steel Mill Lighting Problems

By R. F. SANNER*

There is no problem in a modern industrial plant or steel mill today which is of greater importance than that of lighting. It is generally recognized that adequate lighting in any industrial plant facilitates production and promotes safety.

There are two kinds of lighting, natural and artificial, of which natural illumination, properly applied, is the ideal light.

We are interested at this time primarily in artificial lighting, which is fully sufficient and satisfactory for the area which is to be lighted. In plants where there is no night work, the problem of artificial lighting is not so vital, because approximately only 20% of the total working hours, not including overtime or night work, require any artificial lighting.

R. F. Sanner

Where night work is being done, as is the case in all steel mills, the artificial lighting problems must receive more careful consideration. With the many improvements and developments in illumination, it is possible to obtain sufficient and satisfactory lighting with equipment which is economical and reliable.

An adequate and satisfactory system of illumination may be defined as a system which fulfills the following requirements:

(a) Provides sufficient illumination for every person in the area lighted.

(b) Prevents eye strain by the proper selection and installation of the lighting equipment.

(c) Avoids sharp shadows and glare by carefully placing the lights and equipping the lamps with reflecting and diffusing devices.

(d) Avoids the use of individual lights, except for special cases, by providing general distribution of illumination throughout the area.

(e) Provides for proper maintenance of the equipment at regular intervals.

(f) Provides for turning lights off or on either single of in small groups.

(g) Has a feeder and distribution system so designed as to have available at the outlets, a voltage which corresponds to one of the standard voltages for which lamps are manufactured.

Lighting Equipment:

There are many types of reflecting equipment available for steel mill lighting. The type of lighting equipment to be selected should be determined largely by the character of the work to be performed, the construction of the rooms or buildings, and the color of the walls and ceiling.

There are three general types of lighting equipment available for efficient and economical illumination.

1. Porcelain enameled and glass industrial reflectors.
2. Opal glass enclosing globes.
3. Floodlight projectors.

The tendency has been toward standardization of lighting equipment for the common areas and operations. Consequently, we find the wide use of porcelain enameled steel reflectors, chief among which are the RLM standard dome, the standard bowl, and the angle type reflector. One type of enameled steel reflector, which formerly found a wide application, is the so-called flat plate reflector. These reflectors are from the days before the development of the RLM reflector, and there are still a large number in use. This type of reflector has long been considered inadequate for steel mill use, because the areas in mill buildings which correspond to wall areas in other types of buildings, offer practically no reflecting aid to the lighting system. The use of the flat plate reflector should be limited to outdoor areas because of the noticeable glare produced.

The flat plate reflector has been replaced by the RLM standard dome for outdoor areas because of the latter's greater efficiency and reduced glare. Even if the greater efficiency were not attainable with the RLM dome reflector, the glare produced by the flat plate reflector would warrant the change to the RLM reflector. There have been instances where buildings formerly equipped with flat plate reflectors were equipped with RLM reflectors, using the same size and number of lamps, resulting in a decided improvement in light intensity.

Recently there has been placed on the market a glass reflector for industrial purposes. This type of reflector has not yet found very wide use in the steel mills. In some instances where these glass reflectors have replaced the RLM reflectors for high bay mounting, they have proven to be more efficient and less susceptible to the collection of dirt than the porcelain enameled reflector.

In addition to the RLM dome and flat plate type reflector, there is the angle reflector. This type finds application for areas where it is impossible to mount overhead units; or where it is desired to supplement the overhead system. There are two types of angle reflectors, the elliptical and the symmetrical. The

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elliptical angle reflector is used where a wide lateral distribution is desired; while the symmetrical angle form is best suited for locations where a wide area is illuminated.

Offices in and about a mill are surrounded by an atmosphere which is generally laden with dust. This condition makes it practically impossible to maintain the walls and ceilings so that a satisfactory operating efficiency is obtained. Consequently, lighting units which are dust tight and can be easly cleaned, are desirable. Opal glass enclosing globes are in general use for installations of this type. If globe sizes to prevent excessive brightness are used, ventilating holes both in the globe and holder may be eliminated, thus providing a dust tight unit. These units, if used in the correct size, will furnish a well diffused light without excessive brightness.

Sizes as recommended by the manufacturers are as follows:

Lamp Size Watts	Globe Size Inches
100	12
150	12
200	14
300	16
500	18

Offices located throughout the mill, which have walls and ceilings of such characteristics that they offer little or no aid in directing light to the working plane, present a different problem. In many cases, this problem has been solved by the use of an RLM reflector with a glassteel diffuser, thus having the same properties as an RLM reflector, but giving a more diffused and softer light than the reflector alone.

Yard lighting has proved to be an important factor in the reduction of accidents, as well as an essential requisite in endeavoring to obtain night production approximating that of the daylight hours. Past practice has been to light only those areas used as traffic arteries. However, the present tendency is to extend the lighting to include practically all the property not occupied by buildings.

There are two methods of yard lighting, one which requires the use of floodlights, and the second, the use of the standard industrial type of reflectors or similar equipment.

Floodlighting is particularly adaptable to lighting areas of wide expanse, where it is both convenient and economical to project the light from a distance. Such a method removes the necessity for installing poles on which other types of equipment would have to be mounted, and reduces installation costs to a minimum. Floodlighting requires high mounting for satisfactory operation, hence a minimum height of 50 ft. should be observed, while a height of 70 or 80 ft. should be used if possible.

The use of floodlights has received some very strenuous objection, because of the apparent ease with which the lens become dirty, and the ease with which the maintenance can be overlooked. In some cases, the light output from a floodlight installation has been decreased to practically zero within several days after they have been cleaned, because of the enormous collection of dust and dirt on the lens. Floodlights are very often mounted on structures etc., where they are very inaccessible, and very often overlooked by the maintenance man; thus adding to the decrease in light output. Blast furnace trestles, railroad yards, car dumper approaches, billet cooling yards, and ore storage yards, are all suitable for floodlighting, provided the units are cleaned frequently.

The use of the standard type of industrial reflector is best suited for those areas having an overhead structure, or where adjacent buildings present a convenient method of mounting. Where the yard area is used for carrying on the production process, requirements will be similar to those of the interior of buildings and a similar method of installation is generally possible. Where the area is a passageway, or in reality a road or highway, the lighting requirements are not so rigid, but should be such as to produce adequate results. A maximum spacing of reflectors of five times the mounting height is permissable with the standard equipment, but this spacing may be increased to eight times with the use of the prismatic glass type of yard lighting equipment. The prismatic glass type yard lighting equipment can be obtained in two types, the standard type, giving a symmetrical distribution, and the two way type giving an assymetrical distribution. The former is designed for use where large areas of irregular shape are to be illuminated; while the latter are designed for illuminating narrow roadways and passages.

Frequently you find a reflector being used with a size of lamp other than the one for which it has been designed. This practice tends to decrease the efficiency of the lighting system, and is not one to be encouraged. If a change in the size of lamp is required, the reflector can be readily changed without changing the hood; as this feature of the equipment is generally interchangeable when the same types of sockets are being employed. Good practice calls for the use of the correct size reflector for the lamp size desired.

Power Supply:

The voltage supplied to the lamp is an important factor, from the standpoint of economical operation of a lighting system. Burning lamps under voltage,

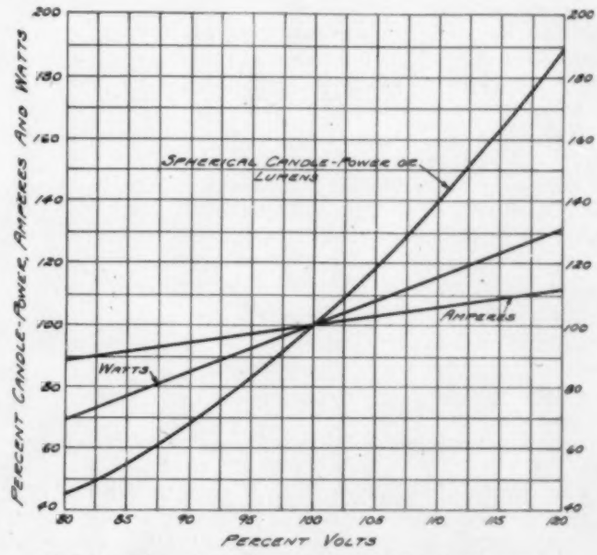

FIG. 1—Characteristic Curves of Mazda Lamps.

for instance, using a 115 volt lamp in a socket at which only 105 volts is available, causes considerable reduction in light output; in this particular example, the reduction is approximately 25%.

Data which is available from a recent lighting survey, shows that the condition mentioned above actually exists in many mills, and in some cases the condition is even worse. Instances have been found where 115 volt lamps were used in sockets where voltages ranged from 70 to 100 volts. This resulted in a light output decrease of 40 to 75 percent, without a corresponding decrease in power consumption.

Figure 1 shows the characteristic curves of mazda lamps. The curve spherical candle-power or lumens illustrates how rapidly the light output from a lamp decrease with a slight decrease in lamp voltage. This decrease in light output is not accompanied by a corresponding decrease in power consumption. Further reference to the curves in Figure 1 shows that a 40% decrease in light output due to operating a lamp at reduced voltage, is accompanied by only a 20% decrease in power consumption.

Very often the reason given for using lamps the voltage rating of which exceeds the socket voltage, is that the lamp life is greater. There is no doubt that longer life is secured, but there is considerable doubt as to whether this operation is economical. As a rule, a lamp costs much less than the power it consumes during its life. Thus it would seem that the most economical procedure would be to get the greatest efficiency from that which costs the most.

Where power feeders are used as the source of supply for lighting, fluctuations in socket voltages are common. These voltage fluctuations may range from 10 to 25% on circuits whose loads are intermittently heavy and light. Conditions of this sort necessitate the use of lamps the voltage rating of which should not be less than the highest socket voltage obtainable. Therefore during times of low voltage, the lighting equipment is operating at very low efficiency. In cases where the voltage fluctuations are very frequent, not only is the lighting output decreased, but the fluctuations in light intensity are very annoying.

The solution to the voltage problems is feeders for lighting service only, and adequate wiring to the lamp socket. The number and size of the lights on a circuit, govern the size wire to be used. In some mills, present practice is to use no smaller than #8 wire for all lighting circuits; and to limit the maximum voltage drop for any circuit to 3 volts. This is probably an ideal condition, but it does indicate that there is an effort being made to correct voltage conditions, both in respect to feeder and branch circuits. Frequently the excessive voltage drop to the socket is due to adding lights or increasing the size of the lamps after the original installation, and not to faulty design.

Directly related to the question of correct supply voltage, is that of whether the service should be 115 or 230 volts. This problem, if viewed from the standpoint of feeder copper, might find its solution in the use of the 230 volt service, because of the lower currents required. However, the disadvantages of the 230 volt service show the desirability of the lower voltage service. The following are some of the disadvantages of the 230 volt service.

1. 220-250 Volt lamps are less rugged than those of 110-125 volts. The filament in the 220-250 volt lamps is one half as large as that in the lower voltage lamps of corresponding wattage, and is thus more liable to breakage.

2. For the same power consumption, the 220-250 volt lamp will give on an average, 20% less light than the corresponding lamp of the lower range; this being a characteristic inherent to the 220-250 volt lamps, figure 2.

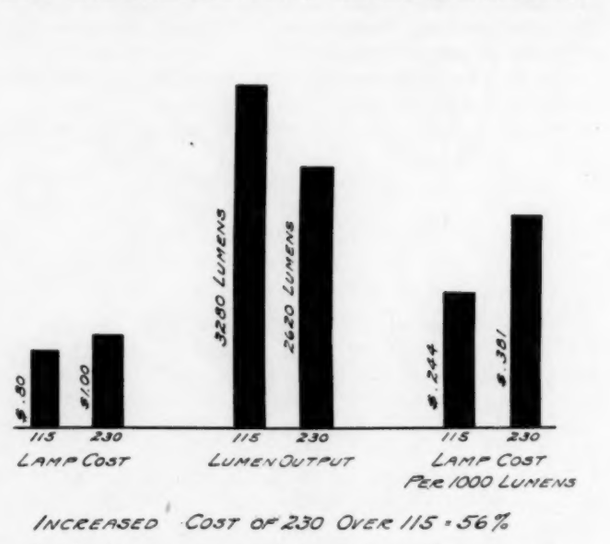

FIG. 2—115 Volts vs. 230 Volts for Lighting Service.

3. The cost of a 220-250 volt lamp is considerably more than that of the 110-125 volt lamp.

All these disadvantages of the 220-250 volt lamps are appreciable advantages in favor of the 110-125 volt lamps. If we would consider only two points in favor of the low voltage lamps, lower cost and greater efficiency, the lower voltage lamp is far more economical. Lamps of the 110-125 volt rating, cost only 80% as much as lamps of 220-250 volt rating, and for the same wattage consumption, the light output is 25% greater than that of similar 220-250 volt lamps. On the basis of lamp cost per 1000 lumens, the increased cost of 230 volt lighting over 115 volt lighting is 56%. These advantages of the 110-125 volt service are shown graphically in Figure 2. Table 1 shows some comparative data on 110-125 and 220-250 volt lamps.

In some cases 230 volt service has been established and instead of using 230 volt lamps, two 115 volt lamps are used in series. It has been learned that this method of operation is not entirely satisfactory. The most satisfactory results from an installation of this sort are obtained when two new lamps are used in series; under which circumstances, the lamps are producing the same amount of light. The first difficulty to be encountered when two lamps are used in series, is that of having one lamp burn out and as a result, the light output from both lamps being cut off until the burned out lamp is replaced with a new one. If only the burned out lamp is replaced,

then we have the condition where the new lamp will receive less than normal current, and will give less than normal light. The old lamp will be forced to carry a slightly heavier current than it would normally carry at that period of its life, and will fail earlier than it ordinarily would.

Several steel mills have adopted the three wire system of power distribution for lighting. This system has the advantage over the two wire system, of using less copper for transmitting equal quantities of power. The outside legs of a three wire system, require only half the copper of the two legs of a two wire system; the third or neutral wire is even smaller than the outside legs. When installing a three wire system, the size of the neutral wire should be checked carefully. If the load should become greatly unbalanced, the voltage drop in the neutral wire may be sufficient to materially decrease the light output. Good practice requires that the load on the feeder wires be checked periodically, to be assured that the load is not becoming unbalanced, and thus loading the neutral wire too heavily.

The frequency of current is a more or less important factor in determining the quality of the light output. 60 Cycle current is better suited for lighting than 25 cycle current, because of the absence of slight light fluctuations which are noticeable from 25 cycle installations. Most mills use 25 cycle current for lighting mill areas, but for offices it has been deemed necessary to use 60 cycle current. Some plants have installed frequency changers for converting 25 cycle power to 60 cycle power for office lighting, and thus have eliminated these light fluctuations where they are most noticeable.

Lamps:

Just recently one of the lamp manufacturers completed an investigation of the various types of mazda lamps in use throughout the steel industry. In general, the investigation disclosed that in a majority of cases, the tendency is to limit the number and sizes of lamps to those of the standard types. However, it was found that some mills are still using large quantities of lamps that cannot be classified as standard.

The lamp companies have concentrated their efforts in perfecting both the quality and manufacturing processes of this standard group, which includes lamps that are suitable for practically all applications. As a result of the more advantageous manufacturing schedule which has been possible, the cost of lamps of the standard group is much lower.

Table II is a summary of some of the special lamps purchased in the steel industry during the past year; together with the suggested standard types that would be suitable for replacing these special lamps.

In all probability, some special lamps are necessary; but it can be safely estimated, that 75% of the special lamps purchased could be replaced by the standard lamps suggested in the above summary. An inspection of Table II shows at a glance that in all cases the standard lamps cost from four to thirty-five cents less than the special lamps. The difference between the special lamp and the standard lamp in most cases is very slight, some differences being, inside frosted glass instead of clear glass, medium base instead of mogul base, thus requiring the use of an adapter; and in one instance a change in voltage, 200 to 220 volts.

In addition, to the use of standard lamps, it is advantageous to limit the sizes of the lamps used in order to keep the lamp stock carried to a minimum. The selection of sizes should not be limited to such an extent as to defeat the ultimate purpose, adequate and suitable lighting. It has been suggested that the following sizes be taken as a maximum: 50-100-200-300-500-1000 Watts and the few special lamps as required by the individual mills.

Maintenance:

Maintenance of the lighting equipment is an important part of any lighting installation. However inadequate a lighting installation may be, the lack of proper maintenance will only add to the inadequacy of the installation.

The dust and dirt which accumulates on lamps and reflectors, in most cases is the cause of poor illumination from an originally good installation. Test data shows that the absorption of light by dust or dirt which has accumulated on reflectors for one month, amounts to ten to 25% of the useful light generated.

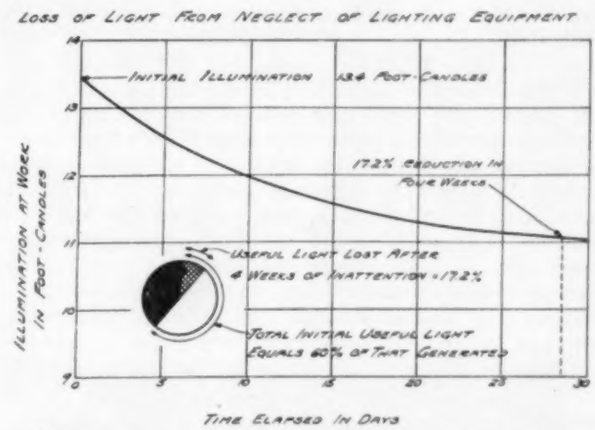
Loss of Light From Neglect of Lighting Equipment
Initial Illumination 13.4 Foot-Candles
17.2% Reduction in Four Weeks
Useful Light Lost After 4 Weeks of Inattention = 17.2%
Total Initial Useful Light Equals 60% of That Generated
Illumination at Work in Foot-Candles
Time Elapsed in Days

FIG. 3—Loss of Light From Neglect of Lighting Equipment.

Figure 3 shows a curve which illustrates how quickly the amount of useful light decreases, as the time since the equipment has been last cleaned increases. This curve shows that to neglect the lighting equipment for a period of 28 days means a loss of useful light equal to 17.2% of its original value. This depreciation would probably be two or three times that in steel mills. Unless the original value of useful light output was very much in excess of that required, a decrease in useful light output of two or three times 17.2% mentioned above, will in all probability make the illumination insufficient for the kind of work being performed.

There have been numerous schedules outlined for cleaning lamps and reflectors. The particular one to be followed depends upon the importance of the lighting installation, and the rapidity with which dust and dirt accumulates. The dust and dirt which accumulates on lamps and reflectors in steel mills, is not very easily removed by merely wiping with a clean dry cloth. The use of some compound, which will remove dirt and restore the lustre on the reflecting surface is far more effective than wiping; and

requires no more time than does wiping. Compounds are available which are easily applied; and do not necessitate the use of anything more than a damp cloth for applying the compound and a dry cloth for removing, after it has dried.

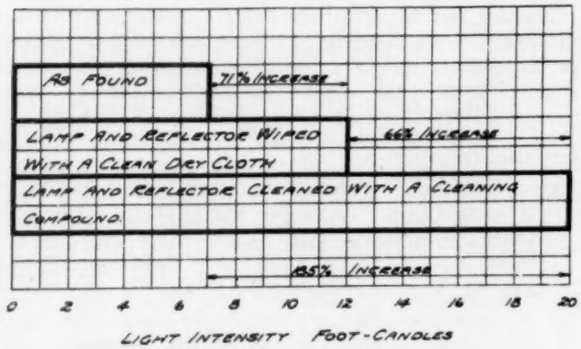
AS FOUND
71% INCREASE
LAMP AND REFLECTOR WIPED WITH A CLEAN DRY CLOTH
66% INCREASE
LAMP AND REFLECTOR CLEANED WITH A CLEANING COMPOUND
185% INCREASE
0 2 4 6 8 10 12 14 16 18 20
LIGHT INTENSITY FOOT-CANDLES

FIG. 4—Results From Proper Maintenance.

Figure 4 shows graphically the results of proper maintenance of lighting equipment. This data was obtained by measuring the light intensity directly under a lighting unit as it was found, after wiping with a clean cloth, and after cleaning with a cleaning compound. The unit tested, was one which had been in service in a blooming mill, and had not recently been cleaned. An inspection of the figure will show, that wiping the lamp and reflector with a clean dry cloth increased the light intensity, 71%; that cleaning the lamp and reflector with a cleaning compound further increased the light intensity 66%. The total increase in light intensity was 185% of the intensity as found. It seems evident, since cleaning with a compound such as mentioned above, requires no more time than mere wiping, and produces twice the results, that the occasional use of some such compound is the best means of preserving good illumination.

The deterioration of the reflecting surface of reflectors should not be overlooked. This deterioration results in the reflecting surface becoming discolored or tarnished; and in the case of enameled reflectors, the enamel chipping. Cleaning will not remove this tarnish or discoloration, consequently the reflector should be replaced.

The matter of lamp renewals seems to be fairly simple, but in reality, it is one part of lighting maintenance which can be easily neglected. Each reflector of a properly designed system, has a particular area to illuminate, and no matter how clean the equipment is, unless the socket is filled with a good lamp of proper size and voltage, that area will have an incorrect amount of light. It would therefore follow, that in conjunction with the cleaning schedule, there should be a schedule for replacing the burned out and blackened lamps with new lamps of the correct wattage and voltage.

To effect these maintenance schedules does not present much of a problem in some industrial plants; but such is not the case in a steel mill. The lights in a steel mill, with very few exceptions, are mounted in very inaccessible places; making the use of the maintenance trucks and other maintenance conveniences impossible. In most all cases, it is necessary for the steel mill maintenance man to carry his supplies, thus making his work very laborious and probably causing him to become negligent.

In order to obtain the best results, it would seem advisable to make the maintenance man's work as easy as possible. This can be accomplished by the installation, wherever possible, of some type of disconnecting hanger which will permit the removal and lowering of the lamp and reflector to the ground. Where this method of maintenance is not possible, it is frequently possible to use the overhead traveling cranes for gaining easy access to the equipment.

Designing the Lighting Installation for Economical and Efficient Operation:

After a lighting installation has proven satisfactory from the standpoint of suffiicent illumination, it must be judged from the standpoint of operating and maintenance costs. During the designing of a lighting installation, is the logical time to give the most thought to the economy of operating and maintaining the installation. A well designed system, is one which not only provides for satisfactory and sufficient illumination at the lowest cost for installation, but one which in addition provides the most economical operation and maintenance.

The following items relative to the lighting installations already in service in the plant, should be given considerable thought and consideration in the design of any new installation:

1. Transformers, feeders, and protective equipment.
2. Size and voltage of lamps.
3. Types and sizes of reflectors and the method of mounting.

The load on transformers, from which the installation is to receive its power, should be checked to determine to what extent they are loaded. Depending upon the amount of load which is to be added to the sub-station, it may or may not be necessary to provide additional transformer capacity it is far better to have some additional capacity rather than run too close to the margin. In most industrial plants, lighting loads are continually being increased, and such increases must be taken care of without any particular concern as to transformer capacity. Transformer substations should be equipped with demand meters for determining the demand on the station at any time, without making a special test. Transformer temperature indicators are reliable for determining the oil temperature, thus assuring constant check on individual transformer operations.

At no time should all the power from a lighting substation, 100 KVA or more, be taken away by one feeder. There should be a number of feeders, each of which will have sufficient capacity for that particular area which it will feed. Each of these feeders should be provided with a circuit breaker for protection in time of overloads and short circuits, and to disconnect only that feeder on which trouble occurs.

Feeders and circuits should be so designed as to provide the proper voltage at each outlet. Probably the most important part of any lighting installation, is to maintain socket voltages very close to the voltage rating of the lamps being used. Previous mention has been made of the desirability of working the lamps close to their rated voltage, as has been shown,

only a small drop in lamp voltage causes a large decrease in light generated.

Feeders should be designed with another thought in mind, that of the future additions of circuits. Continual advances in standards and practices of lighting, make it essential to design the original feeder installation with a margin for the future. Further leeway should be allowed for probable or possible future usages to which the space may be put. It is common to find areas in buildings used for purposes requiring more illumination than the original occupancy. The additional cost of providing liberal feeders at the time of installation, is obviously very small compared with that of providing additional feeders.

Inadequate feeders, caused by load which has been added after the original installation, is directly responsible for the avoidable waste of electrical energy in overloaded circuits; and results in low efficiency of lamps and unsatisfactory lighting conditions. When feeders and circuits are overloaded because of light requirements which are after thoughts, the general illumination of an area which at the time of installation was entirely satisfactory, is being sacrificed for the purpose of increasing local illumination at some point. At least one public utility company has adopted the use of series boosters for raising the voltage on feeders and circuits which have become overloaded due to the addition of load after installation.

Selecting the lamp sizes and voltages for the new installation has a considerable effect on the economy of operation. It would not be considered economical operation, if the number of spare parts stocked was two or three times that which you might have stocked, had you given this consideration at the time of design. Check the sizes and voltages of the lamps which are already in stock, and make an effort to use these lamps for the new installations. Lamps of too many sizes and voltages, result in extra work for the storekeeper, more inconvenience for the maintenance man, and when replacing burned out lamps, greater possibility of replacing them with lamps of improper size and voltage. With very few exceptions, it should not be necessary to stock lamps of more than two voltages; one for use where the lamps on a circuit are all in multiple, the second for use where the lamps on a circuit are connected two in series and then these combinations in multiple. In the first case, all lights in multiple, where alternating current is used, the voltage should be any one of the standard voltages, 110, 115, or 120 volts. In the second case, two lamps in series and these combinations in multiple, 125 to 130 volts. The higher voltage lamps are for use on cranes, etc., where direct current of 250 volts is the only power available, and consequently it is possible to confine the use of such lamps to a very few sizes. The variety of sizes of lower voltage lamps, used for general lighting, to be used and stocked depends entirely on the total number of lamps installed. Where a large number of lamps are used, the stocking of all sizes is justified, and vice versa.

It may seem that in cases where the same size lamp is used for both the low and high voltage service, 110 to 120 volts and 125 or 130 volts, that the economical procedure would be to use only lamps of the higher voltage, which can be used for either service. If the problem is studied more closely, it will be evident that such is not the case. Lamps which are not made for any of the standard voltages cost approximately 10% more than the standard lamp. This increase in initial cost, if there are a great many special voltage lamps used on standard voltage circuits, hardly justifies carrying standardization to such an extent. In addition to the increased initial cost of the higher voltage lamps, the use of the higher voltage lamp on the low voltage circuit will materially decrease the light output for the lamp. Carrying standardization too far, by using special voltage lamps on circuits of standard voltage, cost 10% more for each lamp used and the light output decreases two to three percent for each volt that the lamp is worked under the labeled voltage. Consequently, it costs more money for considerably less light.

The selection of lighting equipment for an installation depends largely upon the kind of work performed, the construction of rooms and buildings, and the color of the walls and ceilings. Therefore the possibility of standardization is not as great as in the case of lamps. Replacements of reflectors and globes is not so frequent as that of lamps; consequently the investment in storeroom stock need not be so great. A selection of such equipment should, therefore, be made with the thought in mind of selecting equipment which will give the best possible illumination, for the particular area to be illuminated.

There are some features of the lighting equipment which must be given consideration as to maintenance, such as rigid or spring suspension, accessibility for cleaning and renewing lamps, and durability of reflecting surfaces. At certain locations where vibrations are present, rigid suspension of a lighting fixture causes excessive lamp breakage. There are a number of vibration absorbing suspension hangers

FIG. 5.

available which have proven to effect amazing savings in lamp replacements. Accessibility of lighting equipment for cleaning is important from a maintenance standpoint. Wherever possible, some type of disconnecting hanger should be used which will provide for lowering the reflector and lamp to the ground, where they can be cleaned more thoroughly and safely. The reflecting surfaces of lighting equipment governs to a great extent the life of reflectors. After a certain period of time, depending upon local conditions, reflectors must be replaced because the reflecting surfaces become discolored and chipped, which materially decreases the reflecting efficiency. The ideal reflecting surface is one to which the least dirt adheres, will not tarnish, discolor, or chip, and can be cleaned and polished with a clean dry cloth.

Some Recent Lighting Installations:

Figure 5 shows a rolling mill, 72 ft.x556 ft., lighted by 42-750 Watt lamps using 20 inch RLM standard dome reflectors. The reflectors are mounted 23

FIG. 6.

ft. above the floor and on approximately 28 ft. centers, thus furnishing a light intensity of 8 foot candles.

Two applications of the high mounting prismatic glass reflector for open hearth interior lighting are shown in Figures 6 and 7. The pictures are of diffent open hearth buildings. The lighting units in both cases were mounted on the center line of the charging and pouring sides of the building opposite the opening between furnaces.

Figure 6 shows the charging floor in one of the open hearth buildings and Figure 7 is that of the pouring side of the other building. The following is a table giving some data concerning the lighting installations and light intensities throughout the buildings.

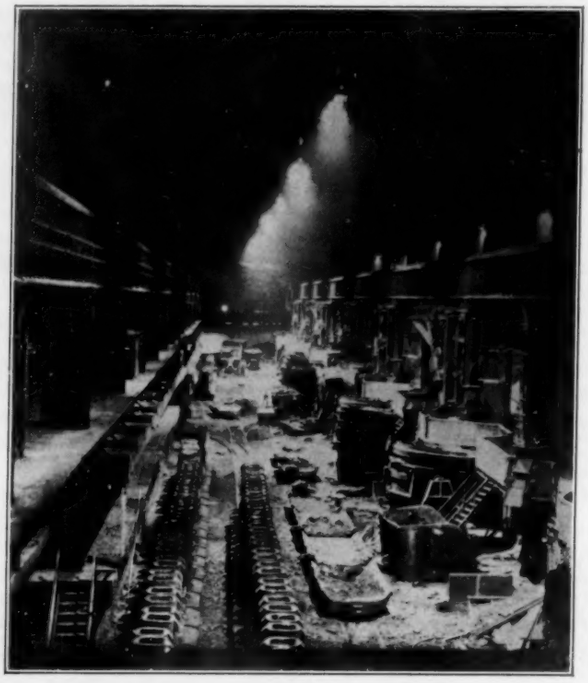

FIG. 7.

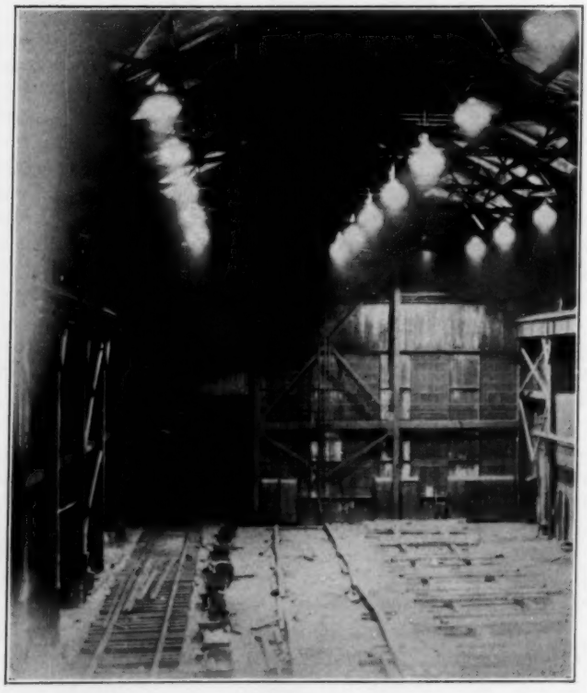

FIG. 8.

General Data

	No. 1 Building	No. 2 Building
Size of lamps (watts)	1000	1000
Mounting heights, charging floor (feet)	46	46
Mounting heights, pouring side (feet)	55	61
Light spacing (feet)	69	80
Number of lights	44	28
Width of building (feet)	130	140
Length of building (feet)	1056	1400
Lighting Intensities (foot candles)		
Charging side, center of floor directly under light	12	12
Charging side, center of floor between lights	6	4.5
Between furnaces on center line between lights	2	2
Under leanto, directly back of light	3	3
Pouring side, center of floor directly under light	6	4.5
Pouring side, center of floor between lights	3.5	2
Pouring side, platform directly back of light	3	2
Pouring side, platform between lights	1.5	1

Another application of the prismatic glass reflector of the high mounting type is shown in Figure 8. This installation furnishes a light for chipping billets which requires very high light intensity. This building is 62'6"x225'0", having three rows of nine lights each mounted at a height of 40 ft. and furnishing an intensity of 22 foot candles on the working surface. To obtain this high intensity, 1000 Watt lamps are being used.

Figure 9 illustrates the use of RLM reflectors for general illumination in a machine shop. This shop is 50 ft. x 544 ft. and is illuminated by thirty-two 1000 watt units, mounted at a height of 25 ft. The average light intensity is 10 foot candles.

FIG. 9.

TABLE I

COMPARATIVE DATA ON 110-125 AND 220-250 VOLT LAMPS

Size of Lamp	100 Watt	200 Watt	300 Watt	500 Watt	750 Watt	1000 Watt	
MANUACTURER'S LIST PRICE 110-125 VOLT	.35	.80	1.25	2.00	3.75	4.00	
MANUACTURER'S LIST PRICE 220-250 VOLT	.43	1.00	1.50	2.40	4.25	4.75	
PERCENT COST 110-125/220-250	81%	80%	83%	83%	88%	84%	
AVERAGE							83%
LUMEN OUTPUT 110-125	1320	3300	5300	9500	14,500	20,000	
LUMEN OUTPUT 220-250	1030	2620	4290	7650	12,600	18,000	
PERCENT LUMEN OUTPUT 220-250/110-125	78%	79%	80%	80%	87%	90%	
AVERAGE							82%
PERCENT COST OF OPERATING 110-125 V. LAMPS OVER 220-250 VOLT	63%	63%	66%	66%	77%	76%	
AVERAGE							69%

TABLE II

SPECIAL LAMPS NOW USED AND SUGGESTED STANDARD TO REPLACE THEM

SPECIAL LAMPS NOW USED						SUGGESTED STANDARD					
Watts	Volts	Bulb	Base	Color	Manufac. List Price	Watts	Volts	Bulb	Base	Color	Manufac. List Price
15	115	S17	M.S.	Clear	$ .25	15	115	A17	M.S.	In.F.	$ .20
25	250	P19	M.S.	Clear	.30	25	250	A19	M.S.	In.F.	.26

Special Lamps Now Used						Suggested Standard					
40	110	S19	M.S.	Clear	.25	40	110	A21	M.S.	In.F.	.20
50	220	P19	M.S.	Clear	.30	50	220	A21	M.S.	In.F.	.26
50	230	P19	M.S.	Clear	.30	50	230	A21	M.S.	In.F.	.26
50	240	P19	M.S.	Clear	.30	50	240	A21	M.S.	In.F.	.26
50	240	P19	M.S.	Frosted	.35	50	240	A21	M.S.	In.F.	.26
50	250	P19	M.S.	Clear	.30	50	250	A21	M.S.	In.F.	.26
50	250	P19	M.S.	Frosted	.35	50	250	A21	M.S.	In.F.	.26
50	275	P19	M.S.	Clear	.47	50	275	A21	M.S.	In.F.	.40
60	110	S21	M.S.	Clear	.30	60	110	A21	M.S.	In.F.	.20
75	115	PS22	M.S.	Clear	.50	75	115	A23	M.S.	In.F.	.35
100	110	PS25	M.S.	Clear	.60	100	110	A23	M.S.	In.F.	.35
100	110	PS25	Mogul	Clear	.70	100	110	A23	M.S.	In.F.	.35
100	115	PS25	M.S.	Clear	.60	100	115	A23	M.S.	In.F.	.35
100	125	PS25	M.S.	Clear	.60	100	125	A23	M.S.	In.F.	.35
100	230	PS25	M.S.	Clear	.70	100	230	A23	M.S.	In.F.	.43
100	240	PS25	M.S.	Clear	.70	100	240	A23	M.S.	In.F.	.43
100	250	PS25	M.S.	Clear	.70	100	250	A23	M.S.	In.F.	.43
200	110	PS30	Mogul	Clear	.90	200	110	PS30	M.S.	Clear	.80
200	115	PS30	Mogul	Clear	.90	200	115	PS30	M.S.	Clear	.80
200	120	PS30	Mogul	Clear	.90	200	120	PS30	M.S.	Clear	.80
200	125	PS30	Mogul	Clear	.90	200	125	PS30	M.S.	Clear	.80
200	130	PS30	Mogul	Clear	.90	200	130	PS30	M.S.	Clear	.80
200	235	PS30	M.S.	Clear	1.10	200	230	PS30	M.S.	Clear	1.00
200	240	PS30	Mogul	Clear	1.10	200	240	PS30	M.S.	Clear	1.00
200	250	PS30	Mogul	Clear	1.10	200	250	PS30	M.S.	Clear	1.00
400	125	PS40	Mogul	Clear	2.15	500	125	PS40	Mogul	Clear	2.00
500	200	PS40	Mogul	Clear	2.55	500	220	PS40	Mogul	Clear	2.40

Patents†

By W. R. Coley*

I have the right to address you as Fellow Engineers, for the reason that I received a degree at an engineering school and then later on either re-

W. R. Coley

formed or went to the bad, depending upon the point of view, and became a patent attorney.

The subject of patents and of the associated activities, trade marks and copyrights, is quite generally misunderstood, both as regards the rights they confer and the methods of obtaining them. This situation reminds me of the thought I had when a youngster, that the street car, for some unknown peculiar reason, burdened itself with a trolley pole which it dragged along; whereas, of course, the street car would be impossible without the trolley pole for conducting the current to the car motors. The same situation applies, to a certain extent, in the understanding that many people have with respect to the patent system. That is to say, some men think that the United States patent system is an unnecessary evil or a fad, whereas the fact that is that the greater portion of the industrial supremacy of the United States is directly or indirectly based upon patents and patent situations.

However, admittedly, patent law and patent practice are relatively complicated, and inasmuch as it is impossible to make patent attorneys out of you gentlemen in the course of this talk, I will endeavor to touch upon only the more important and more interesting phases of patents, from the laymen's standpoint.

The basis on which the United States Patent Office system is founded is Article I, Section 8 of the Federal Constitution, reading as follows:

"The Congress shall have the power to promote the progress of science and useful arts, by securing, for limited times, to authors and inven-

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† Presented before Pittsburgh District Section A. I & S. E. E., April, 1930.

tors, the exclusive right to their respective writings and discoveries."

The life of a United States patent is seventeen years from the date of issue, which, of course, may be several years after the date of filing the patent application in the Patent Office at Washington. However, no real patent protection is secured until a patent has actually issued, inasmuch as an inventor has no rights, in the courts or otherwise, to prevent copying or infrigement of his invention until his patent has actually been granted.

The Patent Office is located in Washington, D. C., constituting one branch of the Department of Commerce, and has no branches or divisions in any other city. The Patent Office comprises something over 60 divisions, the work being divided among them in accordance with classes of apparatus. That is to say, all improvements on the mechanical features of rolling mills, for example, will be examined in a certain division of the Patent Office, whereas electrical controllers or systems will be examined in another division. In this way, not only do the respective Examiners become relatively expert in examining their particular classes of inventions, but this system insures, reasonably well, that all closely related inventions pass through the hands of a single examiner or small group of examiners under a single head, thus preventing, for the most part, the inadvertent issuance of two patents covering the same device or system.

The Patent Office has a personnel of about 550 examiners who handle patent applications, as regards the ordinary examination thereof, as well as additional examiners of interferences and law examiners having special duties, two Assistant Commissioners and the Commissioner of Patents, who is the head of the office and who is directly responsible to the Secretary of Commerce, as an administrative officer. Practically all officers and employes of the Patent Office, except the Commissioner, the two Assistant Commissioners and the Examiners-in-Chief, who are appointed by the President, on the recommendation of the Secretary of Commerce, secure their positions through civil-service examinations.

It is impossible to give a hard and fast definition of what constitutes a patentable invention, since the answer depends on so many factors, and, in the last analysis, is largely a matter of opinion. The wording of the Federal Law on this point is as follows:

> "Any person who has invented or discovered any new and useful art, machine, manufacture or composition of matter, or any new and useful improvement thereof, not known or used by others in this country before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country before his invention or discovery thereof, or more than two years prior to his application, and not in public use or on sale in this country more than two years prior to his application, unless the same is proved to have been abandoned, may, upon payment of the fees required by law, and other due proceedings had, obtain a patent therefor."

In this connection, it will be noted that two-years prior public use in this country or two years prior publication in any country, ("prior" meaning before the filing of the patent application), prevents the issuance of a valid patent in the United States. "Public use," in general, means something beyond experimental use, in that the device or system is fully installed and paid for, or is installed and successfully performs its work, little, if any, further adjustments or tests being made.

Thus, to warrant the issuance of a patent, an art, machine, manufacture or composition of matter must be new and useful, and involve the exercise of what is known as the inventive faculty. In other words, the scheme must amount to more than the expected skill of the engineer or artisan. Just where to draw the line in any particular situation is, as previously mentioned, a matter of opinion, and even when a patent case reaches the courts, the decision thereon is still largely a matter of individual opinion as to the degree and importance of the contribution or advance that the inventor has made.

The expression, "new and useful," bars the patenting of what the Patent Office considers to be frivolous or detrimental to public morals. Here again, of course, this is largely a matter of opinion, as evidenced by the following description of a patent which I have personally examined.

The novelty in this particular case comprised the use of a mirror, in combination with a hook, as a fish bait. The patentee stated that, if the fish were of the game variety, then a plane or flat mirror should be used, as the fish would see an image equal in size to himself and would attack it because of his game instincts, thus becoming fastened upon the hook. On the other hand, if the fish were suspected of cowardice, then a concave mirror should be used, as the image would be smaller than the fish himself and, therefore, the fish would have no hesitancy in attacking. The patent specification went on to say that, whereas these statements applied to male fish, the attraction of a mirror for the female of any species was too well known to require any further description in the specification. Some people might consider this a frivolous invention but the Patent Office, at that particular time at least did not.

Whenever a man conceives an invention, which may mean that he has a sudden brain flash, although usually it means the logical result of research and thought, he should make it a point to prepare a sketch or drawing of the device or system—a free-hand sketch is fully acceptable provided it is clear and complete—together with a written description of sufficient clarity and length to convey to a subsequent reader, an adequate understanding of the invention involved. Naturally, the really new device or novel combination is of most interest from the patent standpoint, so that only a brief reference to parts or elements of the combination which are old in the art or well known, need be made, the emphasis being placed on the new structure or combination of parts.

It should be noted that a novel combination of co-operating elements, even though all are old individually, may be patentable.

Such sketches and descriptive matter should be signed and dated by the inventor, as such, and by at least one witness who understands the invention. While such signature and witnessing are of no particular value, as regards filing a patent application, they are of prime importance in the event an inter-

ference is declared with a rival inventor of the same general subject-matter, as latter pointed out in more detail.

In view of the fact that a large majority of inventions are never built in commercial or even model form, the Patent Office has made the provision that either such actual construction of a device, or the filing of a patent application thereon in the Patent Office, may be designated as "reduction to practice" which, in general, may be considered as a completion of the invention. Which ever date is earlier, that of building the device or filing the application, is also of the greatest importance in connection with interference proceedings.

Consequently, it is the part of wisdom, after an invention has been conceived, to get it down on paper and have it signed, dated and witnessed as soon as possible, and then proceed, either to build the device or file a patent application thereon, provided, of course, the invention is worth such expense, in the opinion of the inventor or his attorney or employer.

The usual procedure, after such sketches and descriptive matter, collectively known as a disclosure, have been sent to a patent attorney, is for him to institute a search in the Patent Office in Washington, of the likely classes of previously issued patents, to determine the apparent degree of novelty of the invention.

In general, such searches are made in the Public Search Room of the Patent Office, to which anyone having business is allowed access between the hours of 9:00 A. M. and 4:30 P. M. Such searches should always be conducted by an attorney or some one familiar with search practice, as, otherwise, it is not likely to produce satisfactory results. In general, the searcher examines the Patent Office manual of classification to determine which main and sub-classes are likely to include patents covering inventions of the same general or specific character. Armed with a list of such sub-classes, the searcher conducts the search proper by pulling bundles of United States patents from the corresponding pigeon holes in the Public Search Room, and examining the drawings or specifications, as necessary, until sufficient material is located to convince the searcher that a patent, or at least a worth-while patent cannot be secured, or until the bundles of patents corresponding to the selected classes have been exhausted.

If it is desired to carry the search still further, copies of most foreign patents are available in the Patent Office, and the search may be conducted in the likely classes thereof. Furthermore, it may be desired to conduct a publication search, either in the Patent Office or in the Library of Congress, or both, through trade magazines and other literature, which may disclose the invention being searched. Ordinarily, however, a preliminary search, meaning one to determine the extent of novelty of a given invention, covers only the United States patents, with, possibly, a brief search through the boxes of foreign patents contained in one or more of the Examiner's rooms, relating to this specific art. A complete search through foreign patents and through publications, might make the cost of the search higher than the cost of filing the patent application.

If the results of the search are favorable, that is to say, if no sufficiently pertinent or anticipatory references, alone or in combination, are located, then the attorney prepares to file a patent application consisting of a drawing (except in the case of chemical compositions or the like, wherein no drawing is possible), claims, specification and a rigidly prescribed oath.

The Patent Office drawing must be of a certain size and on a certain kind of paper known as Bristol board. However, it is not necessary to have a working drawing or even a scale drawing, and no dimensions are designated on the drawing or need be stated in the specification, under ordinary circumstances.

The most important part of a patent is the set of claims at the end thereof, and the drafting of proper claims demands the greatest skill and knowledge on the part of the attorney.

A claim, as regards its form, may be most readily defined as a statement of the invention that does not, however, comprise a mere list of elements nor a narrative or descriptive sentence, and, in fact, that is not a complete sentence at all. It is thus a unique piece of English composition, unlike anything else to be found in any publication.

As an example, a common chair may be assumed to have been once a new piece of apparatus. A mere list of its elements would be as follows: a seat, four legs and a back. While this list is complete, it is by no means a permissible patent claim. A claim on a simple chair of this sort might be written as follows:

> An article of furniture embodying a seat, a plurality of legs projecting downwardly from the corners thereof, and a back projecting upwardly from the rear part thereof.

A claim, therefore, sets forth the relation of each element of an invention to one or more other elements, but does not contain any predicate, and thus is not a complete sentence. Many people wonder why a large number of claims are included in patents, inasmuch as a plain statement of what the invention comprises could be made in one or two claims. Some patents, in the more complicated arts, such as adding machines, contain hundreds of claims. The reason for an apparently undue number of claims is as follows. In the United States patent system, each claim is considered as a little patent by itself, and must stand on its own merits. Consequently, when a patent is litigated in court, it may be that certain claims will be invalidated by reason of an earlier patent, a publication or a public use; another claim may be thrown out by the court because of vagueness, indefiniteness or inaccuracy, or because, as construed by the court, it does not read upon, or is not fully supported by the disclosure in the patent.

Consequently, it becomes the duty of the patent attorney to draw not only the broadest claims which the invention will support, and which his imagination can conceive, but he must also draw claims of medium breadth and some specific to the complete device, as well as claims covering both broadly and narrowly, any novel sub-combinations or elements or parts under the main combination. Furthermore, he endeavors to cover the invention by claims differing but slightly in scope, but utilizing different phraseology, with the thought in mind that, if one

broad claim, written in a certain manner, is thrown out by the court for one reason or another, another claim, practically as broad, will be sustained and the defendant held as an infringer thereof, or that at least one of the claims will be held valid and infringed.

Moreover, in the event of suing an alleged infringing party, the plaintiff or owner of the patent has the right to select only such claims as he desires, on which to sue, depending on what chances he considers he has to obtain a favorable decision from the court, as respects infringement, clarity and validity.

In other words, a patent attorney, in drawing a large number of claims, many of which sound alike to the layman, is not merely making a job for himself, but, in view of his past knowledge and experience, he utilizes his skill to the utmost to foresee and cover all possible contingencies that may arise in the future, when the time comes for a court to decide whether certain claims are infringed, are clearly stated, and are valid. Bear in mind, however, that, if one claim is held valid and infringed by the court, the owner of the patent is entitled to the collection of royalties or damages to just as great an extent as he would if 100 claims were so held.

The specification or body of a patent application is, in general, a descriptive essay, setting forth the structure and operation of the invention. The description proper is preceded by broad statements as to the objects and advantages of the invention, and a reference to the figures of the drawing. In describing the invention, reference characters are liberally applied to the various parts of the drawing, and mentioned as occasion demands.

The oath, which is required in connection with the filing of every patent application, sets forth the citizenship and residence of the inventor, and that, among other things, he believes himself to be the original, first and sole inventor of the device, that it was not known or used before he invented it, and that it has not been published in any country more than two years before filing.

, The government at present requires a filing fee of $20.00 for an application containing from one to twenty claims, and an additional $1.00 per claim for any number of claims greater than twenty.

When the application is received by the Patent Office (it and all other communications relating to it should be addressed solely to the Commissioner of Patents, and not to any individual in the Patent Office) it is classified and distributed to the proper division of the Patent Office, where it awaits its turn. At the present time, the Patent Office is somewhat congested with work, as always occurs during periods when industry and business are in the upper levels, with the accompanying large number of inventions and patent applications.

The function of an examiner in the Patent Office is almost entirely a destructive one, in that his main purpose is to locate, if possible, any prior patents, publications, etc., that, in his opinion, anticipate any or all of the claims, and also to raise any objections he may have to the phraseology or form of the specification and claims. His rejections and objections, applied catagorically to the claims, are embodied in a letter and mailed to the attorney of record. The attorney must answer such Patent Office Action within six months of the mailing date thereof, or forfeit certain rights, whereas the Patent Office itself takes whatever length of time it desires or requires to reply to communications from the attorney. Such communications, in response to the Patent Office rejections, are known as amendments, and in them, the attorney argues as to why certain claims, as originally presented, are patentable over the references cited by the Examiner, or revises or amends the claims to avoid the references or objections, pointing out how they so avoid, or cancels some of them, if he believes there is no hope for them, or adds some claims if he considers that this is desirable in the light of the situation as it then appeals to him.

These Office Actions and Amendments proceed back and forth for varying lengths of time, but it is unusual for a patent, in which all protection possible has been obtained by an aggressive and skillful attorney, to issue inside of a minimum of three years. In this connection, of course, you should bear in mind that there are different qualities of patents, the same way that there are different qualities of shoes or hats. In other words, it is possible to obtain some sort of patent with a small number of narrow claims, relatively easily, but such patents are not worth having, generally speaking, as they are too easily avoided by adverse parties desiring to exploit the real essence of the invention. However, if a skillful and aggressive attorney is on the job, he will squeeze out the last drop of invention and see that the disclosure is fully and adequately covered by as many claims as he deems desirable.

Sooner or later, of course, an issue is reached in the Patent Office, whereby either all of the claims in the case are considered allowable by the Examiner, and he sends a notice to that effect to the attorney, or after a second rejection on the same references, and for the same reasons, he gives a final rejection of some or all of the claims. When the latter occurs, further prosecution before the so-called Primary Examiner is terminated. The applicant must either cancel the rejected claims, or appeal them to a higher tribunal in the Patent Office, namely, the Board of Appeals.

If the application is allowed, it is necessary to pay the final Government fee of $20.00 within a six-months period. Here again, the $20.00 covers any number of claims up to twenty, and an additional $1.00 per claim must be added for any larger number. After the final fee is paid, the official Government document, known as Letters Patent, with a blue ribbon and red seal, and an identifying number, issues in about a month. This official document is the necessary basis for a suit for infringement in the Federal Courts.

On the other hand, if the case is finally rejected, and an appeal to the Board of Appeals is filed, an oral hearing is set for several months later, in fact, over a year later at the present time, because of the congested condition of the Board's docket. The attorney appears at the hearing, argues the case, answers any questions the Board may ask, and files a brief. Within the course of two or three months, a decision is rendered by the Board, either affirming or reversing the Examiner's final rejection, or a split decision may be rendered. If the decision is satisfactory to the applicant, or if he decides not to carry the matter further and has any claims at all allowed, then he can shortly secure an allowance of the application and take out his patent.

On the other hand, if he desires to appeal the matter further, this may be done by resort to the Court of Customs and Patent Appeals, in Washington, where oral arguments and printed briefs are presented before the court comprising five judges sitting on each case. In general, the decision of this court is final.

It should be borne in mind that a patent is a contract between the patentee or patentees, and the Government of the United States, representing the remainder of the people. The basis of the contract is that, in consideration of the inventor or inventors disclosing to the public a new and useful advance in some art, machine, manufacture or composition of matter, the Government grants him or them a so-called monopoly for a period of 17 years. However, there is a rather general misunderstanding as to the nature of this monopoly. A patent is not a positive right to manufacture, use and sell the device covered by the patent, but, on the contrary, is a right to exclude others from making, using and selling your particular invention. This leads to a discussion of the little understood difference between patentability and infringement.

Patentability involves the novel feature or features that distinguishes your invention from all prior patents, publications, ets., and entitles you, in the eyes of the Patent Office, to a patent covering your novel contribution. In other words, if your device is sufficiently distinguished from prior drawings, descriptive matter and installations, that is, from the substance of all prior inventions, then you are legitimately entitled to a patent and it will be a valid one.

However, irrespective of validity or invalidity, as soon as you desire to manufacture, use or sell the device covered by your patent, it must be first determined whether or not it would infringe any of the valid claims of previously granted patents. This means further search work in Washington to determine whether or not you have the right to use the device covered by your patent, that is to say, whether or not your device infringes one or more claims of any adversely held, earlier issued patent. If such infringement does occur, then, in general two courses are open.

One is to conduct a still further search to enable your attorney to decide whether or not the infringed claims are valid, that is, whether or not material in the way of prior patents, publications or uses can be located of such nature as to invalidate or anticipate the troublesome claims. If such claims cannot be invalidated, then the only course is to secure a license from the owner of the infringed patent, who, of course, can set his own terms. If he refuses to grant a license or asks such exorbitant terms that it is impossible to build your device, and make a profit thereon, there is nothing that you can do about it, even though your own patent is 100% valid.

It is of interest to note that the Patent Office is issuing around 900 patents per week, and that between 1,700,000 and 1,800,000 United States patents are now out, all of which, theoretically at least, must be avoided by any claims drawn by patent attorneys at the present time. You can appreciate, therefore, one reason why patent attorneys have their troubles and get gray-headed or bald-headed before their time. In this connection, it is also of considerable interest to note that about the year 1849, the then Commissioner of Patents resigned his office for the reason that, in his opinion, inventions had been exhausted, that no more patents would be likely to be granted, and that he desired a job that would provide steady employment for the future.

An important feature of patent practice is known as interferences, that is, cases where two or more applications of rival inventors, or an application and a patent, contain, or are judged capable of supporting, one or more identical claims. In such a situation, of course, it is necessary to determine, by proper evidence, who is the prior inventor of the subject matter of the claims in question.

Such an interference arises between two applications after one of them is in condition for allowance. The Patent Office Examiner makes a final survey of the situation, in the endeavor to locate any other applications which may be capable of supporting certain of the allowed claims. If he finds one or more, the claims in question are suggested to the applicants, who, if the claims are copied, then have the right to contest for the ownership of such claims.

After the issue is thus joined, preliminary statements are required from the respective inventors as to when the invention was conceived, when the first written description and the first drawing thereof were made, when the first disclosure to another was made, when it was first reduced to practice (by building a device or filing a patent application), and the extent of use, if any. These statements are sworn to and filed in the Patent Office by the respective inventors before either party knows what the other's dates or allegations are. Consequently, the importance of having accurate and complete data along these lines, capable of being legally proved, will now be evident, as the case may be won or lost by reason of the condition of the early papers constituting evidence of the invention.

After the preliminary statements have been received and filed, the opposing parties may obtain copies thereof, after which it is in order to make certain motions, such as adding claims, or, in case it appears that the other party is likely to win, a motion will probably be made by the apparently losing party, to the effect that the claims in controversy are unpatentable over certain prior art or that the opponent has no right to make such claims. After oral hearings on these motions in the Patent Office, provided the issue between the parties still remains, times are set for taking testimony, first by the so-called junior party, meaning the one who filed his application last, and then by the senior party. The advantage of having the other party take his complete testimony first is, of course, an important one, and illustrates the value of filing a patent application as soon as possible after an invention has been made.

The taking of testimony is not done in open court, but before a Notary Public or other official who is qualified to administer oaths, the witnesses being sworn and the opposing attorney having the right to cross-examine. In fact, the conduct of such taking of testimony is substantially the same as that of taking testimony in open court, with the exception that no judge is present to sustain or over-rule objections to questions or answers. However, such objections are placed on record and taken into ac-

count by the Patent Office when the record later comes before the Examiner of Interferences.

After completion of direct and rebuttal testimony, printed briefs are filed in the Patent Office and an oral hearing, with both parties present, is had in the Patent Office. As a result, a decision is rendered by the Examiner of Interferences as to who, in his opinion, is the prior inventor of the subject-matter in controversy. If the losing party desires this decision may be appealed first to the Board of Appeals in the Patent Office and later to the Court of Customs and Patent Appeals. Usually, both patents eventually issue, the claims in controversy being contained in the patent taken out by the finally-adjudged prior inventor.

In case of infringement of one or more claims of a patent, unless a suitable license is arranged or the patentee is convinced by the infringer that his claims are invalid, a suit in the Federal Court may result. This, in general, is handled like an ordinary civil case, except that, usually, the trial is not before a jury. The suit may be begun in the court of the District where the infringement occurs, provided the defendant has an established place of business in that District, and its decision may be appealed to the corresponding Circuit Court of Appeals. If infringement suits are carried on in two different Circuits, there being ten such Circuits in the United States, and the opinions of these Circuit Courts differ, then the matter usually may be taken to the Uinted States Supreme Court, by means of a writ of certiorari, for a final decision.

It will be understood that this is merely a thumb-nail sketch of patent court practice and is not intended to be at all complete.

In addition to the patents which we have been so far considering and which are known as utility or mechanical patents, there are also design patents, which may be issued at the option of the inventor for terms of 3½, 7 or 14 years, covering "any new, original and ornamental design for an article of manufacture."

The ornamental feature, which involves aesthetic appeal to the eye, is the gist of a patentable design, and not the usefulness of the device itself.

Trade marks may also be registered in the United States Patent Office, but, as distinguished from patents, no trade mark may be registered until actual use thereof has been made by applying it to an article sold in interstate or foreign commerce, or in commerce with Indian Tribes. The property right in a trade mark is thus acquired, not by registry in the Patent Office, but by actual use of this sort. However, subsequent registration in the Patent Office is valuable as showing ownership of the trade mark, and, undoubtedly, is a great deterrent, as regards unauthorized use thereof. Furthermore, the registration of a trade mark gives the right to resort to the Federal Courts.

Copyrights are granted by the Government for an initial period of 28 years, which may be extended for another similar period, to an author or owner of a work of art, musical composition, a writing, a drawing, a motion picture, an illustration, etc. Copyrights are handled by a copyright-registration office connected with the Library of Congress, and are obtained merely by mailing two copies of the article or drawing to the Library of Congress, together with a fee of $1.00, whereupon the article may be marked as copyrighted.

The Patent Office also registers "prints or labels designed to be used for any other article of manufacture."

A resume of the functions of a patent attorney will be of interest at this point. His chief function is to provide protection for the particular industry or client with which he is affiliated, in a double way. In the first place, the attorney covers inventions under the sanction of the United States Government and thus secures a certain monopoly with respect thereto. Secondly, the attorney or at least the corporation attorney, assists engineers to develop and expand new or uncrowded fields, and also avoid adversely held patents in any particular line of activity. Thus, the attorney files and prosecutes patent applications to issue, with or without appeals or interferences, purchases patents or secures licenses thereunder in order to build up situations surrounding a commercial development of importance, conducts infringement or right-to-use searches, or validity searches, or validity searches, where necessary, and, in the case of a corporation patent attorney, spends considerable time in studying and evaluating inventions submitted by both employees and non-employees. In addition, he gives patent approval of publications, articles or devices that it is desired to make in order to determine whether all inventions therein have been properly covered, whether such devices or articles may stimulate competitors to make certain inventions, and if so, to forestall them, to determine whether or not any valid adversely held patents or possibly pending applications may have to be avoided, and just what is the scope and proper construction of certain patent claims. Finally, in this connection, his opinion is sought as to whether or not it is taking an undue business risk to manufacture and sell certain apparatus.

In particular, the corporation patent attorney is active in suggesting new or modified devices as regards guidance in avoiding adversely held valid patents, and stimulating the making of inventions in undeveloped or uncrowded fields, or fostering engineering design in directions that promise new inventions, particularly if the trend of the art is such as to lead to the belief that important commercial developments will occur in connection with such stimulation.

It will be noted, therefore, that patents, in some cases, act as protection for a particular device that is being marketed, and, in other cases, are of protective value by preventing competitors from developing or patenting alternative or modified forms, whereby the patent situation surrounding a given device is greatly reinforced. Moreover patents may be used for licensing competitors where it is deemed advisable, thus providing a certain income, and in addition ,causing the competitor to be less keen about attempting to avoid the patents under which he accepts a license and tying his hands as regards trying to invalidate it, whereas, the opposite might be the case if a license were refused.

In general, the work of a patent attorney, therefore, bridges the gap between the actual development or engineering design work of either a commercial or an undeveloped nature, and the securing and conserving of a form of monopoly on the results of such work.

Patents†

By W. R. Coley*

Discussion

Discussed by

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J. F. Kelly, Chairman: Mr. Coley is certainly to be congratulated on this wonderful paper that he has presented before our Association tonight. It will be a valuable addition to our Proceedings. I am sure that there are many questions that you will want to ask Mr. Coley and we will now throw the meeting open for general discussion.

N. C. Goin: From your description, if you make a device or file the application, they both mean the same thing in the eyes of the law later on?

W. R. Coley: Absolutely.

N. C. Goin: If you file the application, you won't have to make the article right away?

W. R. Coley: You have to file your patent application within two years from the time it was reduced to practice, that is, if it went into public use. If you make an invention and do not put it in public use or use it in some way where the public can see it, then you are allowed any reasonable time after that to file, but if the device goes into public use you must file within two years. If you delay a case too long after you reduce it to practice, that is, after you build it, another fellow may come along with the same idea and you are up against the situation as to whether you can patent your invention. It is not the first inventor who necessarily receives the patent, but the man who is sufficiently diligent in taking a patent out; the idea being that you teach the public something it did not know before.

J. F. Kelly: I have in mind something that has been in use sixteen years, and later on, another man exploits it and puts it to use, can the man who exploited it in the seventeenth year apply for a patent?

W. R. Coley: Yes, but he could not get a good patent. People get such patents, but they are no good. They will be thrown out if you produce the proper evidence in court.

F. H. Moyer: There are many things to be said in connection with patent developments. The first thing I want to speak about: You would hardly believe that one of our best actors is a wonderful inventor. He invented the shield while eating grape fruit; the idea of the fork with the projecting tines; eating corn on the cob. This year he has two ideas, a matchless lighter which he hands to his friends, who say, that is no invention in that it is not different from other lighters that won't light—but what is this tab sticking out here? You pull it out and there is a box of matches inside. He has an old-fashioned rat trap for getting rid of rats. This shows his originality. The trap is made of copper shaped like an ordinary trap. He was explaining to his friends how you take a piece of bacon and put it in the center on a wire that attracts the rats. The rat smells the bacon but there is no way for him to get into it, and so he worries around and finally brings in another rat; so the two rats worry around for a while; and finally they go down and get the master rat in the house. The three weary themselves out trying to get at the bacon, get disgusted and say, "let us go somewhere else," and leave the house. There is a fellow that has an active and analytical mind.

Speaking of inventions in particular, I believe a good many people have not realized what changes in their business means, unless they have kept up with the patenting and development of new ideas. I can remember years ago when we looked on inven-

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† Presented before Pittsburgh District Section, A. I. & S. E. E., April, 1930.

tors as more or less cranks on one subject or another. They would apply to the patent office for patents on all kinds of freak schemes. The patent office is littered with thousands of such patents. But in later days it has worked around to where invention is a constituent part of an industry, just the same as development of machinery. The larger corporations maintain research departments and they are not guessing at results; they are analyzing and studying and the wonderful progress made in the last twenty years is due to research and patenting ideas which have been substantially the basis upon which the present-day business is built. In 1900 it was considered science had reached the peak and there was nothing new to invent. The first thing to come out with the beginning of the new century was the wireless. It is useless for me to itemize the things since then which are remarkable. I might mention a little device gotten out by the Westinghouse which is used as a safety device in connection with their electric iron. Heat or cold will make it buckle. When temperature reaches a certain point, the coefficient of expansion shuts off the current and you cannot overheat or burn out the iron. There was a fellow who had an idea. I am a "crank" in talking about ideas, because ideas come from mind pictures. You read things and observe things and after a while you get outside and start to look on at these things which have gone past. New mental pictures will be continually coming along, and because the idea has to be developed, many good things have missed the patent office by the fellow who thought of them first. In my own case, in 1901, I had an idea I could make an electric mechanism for throwing a switch. I submitted it to a patent attorney who ridiculed the idea. Then I showed it to some practical man, who said "it will freeze up." But, nevertheless, nobody gets out of a car today to throw a switch.

Another thing along that line is the electric headlight on locomotives, A man by the name of Edwards conceived the idea of throwing two shafts of light indicating the direction from which the train was approaching. The objection was that an electric headlight would dazzle the engineer, that nobody could sit and drive a locomotive with an electric headlight. The fellow lacked foresight to push it.

There is a new drive out for blooming mills, each roll being driven separately. From our standpoint we hate to see that, as we still have big pinion stands. But it has been adopted by several plants and is a new step in the direction of electrical equipment.

Some years ago I was chief engineer in a plant and there was some trouble with the electrical mechanism, but they could not find where it was. The general superintendent remarked, "I wish we were back in the old days; if that was a busted steam pipe, I would know where to look for it."

We now have push button controls and automatic speed regulation. Mr. Jeffries was telling me of a man that had a certain device where the speeds could not be controlled. It was a mill with 3 stands, continuous, and no means to regulate the two motors so they would not throw a loop in the bar and stretch between these stands. That control has now been worked out and motor regulated so there will not be too much loop.

Those things are subjects of patents, and to my mind these research departments are going to have to be followed out by the smaller companies as well as the larger companies.

Am very glad to be here; did not expect to be called on to say anything, but appreciate it very much, and thank you.

J. T. Gilboy: When a patentee discovers someone is starting to infringe his patent, what is considered good practice—to go into court of equity and seek an injunction forthwith, or notify the infringer to stop manufacture immediately?

W. R. Coley: Not right away. Where infringement occurs, if you want to hold that party there are two possibilities. If you put out metal or other name plates on a manufactured device, giving the number of the patent, you can expect to collect for as far back as you can prove name plate notice and as far as that fellow has been infringing. But if you don't bother to put these plates on, you can only collect from the time you have given the party special written notice of infringement. The usual procedure is for him to come back and say he does not infringe, that your claims are invalid, and include any other arguments he can think of. Regardless of how long he takes to consider the matter, you can go back and collect, at least from the time you gave notice of infringement or possibly since you had name plates out. We feel you should give a man plenty of time to let his attorney talk the case over and make the necessary search in Washington to show you the strength of his case, and then after a show-down, if your claims are valid, sue if he won't settle.

A Member: Some statements you have made seem conflicting. You stated the examiner makes a thorough search at the time of filing the patent application, but a man may not have an equitable claim after a patent is issued and his attorney must make another search. Is it not the duty of the patent examiner to find that out before issuing a patent?

W. R. Coley: The duty of the patent examiner is to make as thorough a search as time and his disposition permits, and if he fails to dig up any anticipatory patents—he seldom goes into other publications—if he fails to dig up pertinent United States or foreign patents, then you can take the patent out; but if you want to manufacture, use or sell the device —patented or not patented—then your attorney must make a thorough search to find out if any claims of prior patents are infringed or will be infringed if you manufacture that device. Your device is patentable if you have something new, but whether or not you can build a device depends on whether somebody has patents earlier than yours which contain claims broad enough for you to infringe.

Take the telephone as an example. Alexander Graham Bell got patents out based on a claim which read about as follows: "means for transmitting-a current of electricity along a conductor in accordance with variations of the human voice." It would have been impossible to build a telephone which would not infringe that patent, but after Bell got his original patent, there were hundreds and thousands of patented improvements on telephones. However, up until

the time Bell's patent expired, 17 years after, nobody could build either that telephone or their own telephones regardless of how much improved, without paying tribute to Bell, or without his permission.

You get your patent, but it may be no good to you. It is just a piece of paper unless you can get permission of anybody holding prior patents over you, or unless there are no such patents. The distinction between patentability and infringement is a very important one. A thing is patentable if you have something new in the way of a design, but it is an infringement if in building the device, you do not avoid the claims which an attorney has drawn in some earlier patent. A patent attorney's chief job in preparing an application, is to see that he will catch as many as possible future infringements by those who will make changes in the original invention. Furthermore, many an issued patent is really invalid, as a more extensive search than the patent office made, reveals anticipatory publications or public use. Thus the Government, in issuing a patent, does not give any guarantee with it.

A Member: Suppose a man has an idea, but the market is not ready for it, such as the automobile stop-light. Somebody brought out an idea like that 15 or 20 years ago, but there was no market. But suppose I had an idea there would probably be a market for it in the future, file it away and say nothing about it, then at some future time bring it out and try to patent it.

W. R. Coley: It is still patentable if never in public use or if it has never been in any publication. But if another inventor comes along and makes substantially the same device, files a patent application and puts it on the market, and then you come along and say, I invented that first and you try to take your patent out, you are out of luck. It is not the first inventor who is entitled to the patent, if he slips or delays too long, but the first man who is sufficiently diligent in filing a patent application and informing the public of what his idea is and putting it in a position where it can be seen, is the fellow who gets the valid patent. If you are ahead of your time, the best thing is to file a patent application and give your attorney instructions to delay its prosecution as long as possible. In some cases, he can "delay" it for 10 or 15 years if he wants to. You are not losing anything as your patent begins to run only when issued. In foreign countries, the life of a patent starts when you file it, but in this country you can keep it in the patent office for years. That Selden patent that Henry Ford knocked out was in the Patent Office 30 years. All the automobile people were paying royalties to Selden, after the patent issued. Formerly you did not have to answer a Patent Office action for two years, but now you have to do it in six months. There is nothing illegal about such delay; just "knowing the game."

John A. Graham: How many patents on the same idea are in the patent office at once?

W. R. Coley: The best example in answer to that question is "Eskimo Pie." Forty people at the same time had that same idea. When applying for a patent if you can put up a good enough story, about employing people, obtaining capital, etc., after the patent has issued, the commissioner will make your application "special" and run it through ahead of turn. A woman examiner rushed a "special" application through in the case of Eskimo Pie, and thirty-nine other people claimed she made a mistake. They had considerable difficulty in straightening out these other thirty-nine claims of priority. There is no way of telling if another invention like yours is already covered in a patent application, as all such applications are secret documents, except by filing your own case, and awaiting results. In the big majority of cases, no interference with a rival inventor occurs in taking out a patent.

J. S. Rashba: What is the average length of time—suppose everything running along smoothly—from the time the patent is applied for until granted?

W. R. Coley: If your application is handled by a busy attorney, the chances are he doesn't get around to answer these patent office actions much inside of the six months time allowed. You will need at least three of four patent office actions and amendments by your attorney before you will get what is coming to you. If you want a patent that is not merely a patent in name, but one that is as good as anybody can get, that usually takes at least three years, even when you are working on it diligently and not trying to delay it.

J. S. Rashba: Suppose a man wants a patent on something as soon as possible, wants immediate protection, files his claim and starts producing it. A similar manufacturer immediately infringes, can he be held for that infringement?

W. R. Coley: You may be able to get the Commissioner of Patents to speed up your case to give it special action. That is all you can do.

J. S. Rashba: There is no infringement until such time as the patent is issued?

W. R. Coley: No. The patent carries restrictions to prevent others from making, using or selling your invention, but you cannot do anything to prevent infringement until such time as the patent is yours. If you want, you can get out an injunction preventing everybody from using an infringing device they bought from a competitor before your patent issued; but manufacturers are not going out and harassing future customers that way. You can't go back and catch the manufacturer for what he did prior to the issuance of your patent, but you can stop everybody from using your device after such issuance.

Roy T. Wise: What are some of the hazards of making it special? You can file affidavit showing sufficient capital to manufacture, that you will increase the employment of labor, make report and patent the mechanism within three months. But there are some hazards in connection with having a case made "special;" will you tell us about them?

W. R. Coley: I have never had a case made "special" myself. We have found it usually pays to let a case drag along. The chief hazard would be the very one that occurred in connection with "Eskimo Pie." A patent is rushed through with claims which, for lack of thorough search, are not valid. Your competitors get busy and ruin your patent to such an extent that the Court may decide there is nothing in it at all. That is the only hazard I can think of just now. It is the same old hazard of rush work. If you put a rush job through, the chances are it is not thoroughly done.

Roy T. Wise: There is then really no hazard if you have taken care of your background?

W. R. Coley: Not if you have taken the precaution to examine carefully into the records. In some cases we have made our own searches, to supplement the work of the examiner. In one case the examiner said we gave him 6,000 pages of references on our own initiative. We finally got out a patent. I do not think that ever will be duplicated. That is an unusual case. What you depend on is that if you have a large number of claims and some are knocked out, there are more chances some of the others will stick.

A. S. Bemis: In a case where a second party commences to manufacture an article that has been previously made secretly by the original inventor, who did not see fit to patent his invention, what legal protection can the first party expect? We will assume that the second party may either have hit upon the process independently or that he gained the secret from some employee of the first party.

W. R. Coley: If you are depending on a secret business, you are protected as long as you keep it secret. If somebody finds out what that is, through talking with employes, he cannot take out a valid patent, but neither can you if you have had it on the market for over two years. The situation becomes one of ordinary competition. You cannot get a patent for an article that has been on the market for two years. He can't stop you from making it; neither can you stop him. Anybody can get a copy of your patent for 10 cents and find out what you know about a given patented scheme. On the other hand, if you keep a device secret, you are counting on possibly a large number of employees who may know enough to be able to develop your stuff. The only point is, can you keep the secret. We do not attempt to take out patents on all of our shop practices. For 10 cents, after the patent issued, our competitors could find out about such a shop practice, and we might never know of their activities. You should not patent everything. You want to use judgment on what is worth while patenting.

N. C. Goin: If you have a piece of mechanism that there is a big demand for. What protection would you have if you started to sell, even if making application before you sell the first one, selling before the patent is issued?

W. R. Coley: No protection at all. If a live manufacturer comes along and starts to make what you put on the market, however, he does not know but what next week or next month your patent will come out and he stands to lose everything he has spent in the way of equipment. About the only protection is whether or not the average fellow is willing to take a chance on your patent coming out soon.

F. G. Boura: What is the value of a name plate to the Patentee with the term "patent pending"?

W. R. Coley: Not a thing. They are resorted to mostly by small manufacturers who are not familiar with patents. Everybody knows that a company like Westinghouse is patenting everything worth while, but actual protection begins only after the patent has been issued.

J. B. Ricketts: There are three things I wish to speak about tonight. One of them has been discussed already in the meeting, viz., the advantage of keeping an application pending. There was one instance I know of—not connected with the American Rolling Mill Co.—where a patent application was filed in 1888 and the patent issued in 1920. The original application contained over 400 drawings, quite voluminous and many pages of specification. The Examiner passed on it many times. The inventor made many trips to Washington, interviewed the Examiner, occasionally hired an attorney to prosecute his application, and other applications, and at times handled it himself. He could not always borrow money. Then he would go back and work on it himself. Thirty-two divisions were required. He realized that it was to his personal advantage to keep the case pending as long as possible and let somebody put the device on the market and keep it there for a few years, which he did. It was fought out in the courts and compromised.

In my daily work in the mill with the mechanical and electrical engineers and research men, I find three questions being asked continually and I am called upon to answer them. I am going to ask Mr. Coley these questions and let him explain them to us. No. 1—Is an idea patentable?

W. R. Coley: It all depends on what you mean by an idea. A mere mental conception is not patentable. What you can patent is the means for accomplishing a result. If you have a wonderful idea to transmit great volumes of power by radio, that is fine; but you cannot patent that idea. Get apparatus or mechanism that will do that, then you can patent your means of transmission or mechanism.

J. B. Ricketts: Question No. 2—Suppose you note the issuance of a patent, and decide you would like to make a similar device, not to be sold but to be secretly used by yourself in your mill; are you infringing the patent when you make a similar device for your own exclusive use?

W. R. Coley: Absolutely. Infringement consists of making, using or selling a patented device without a license. You don't have to sell it out in the open to constitute infringement. If a new hook-up comes out for a radio and is patented, if you manufacture that in your home, you are guilty of infringement. You don't have to account for it, and very often the patentee would not do anything about it if he knew it, because suing for infringement of patents is like everything else, you will do it if it pays, but you won't spend $10,000 to collect $5. But if you make, use or sell, secretly or in any other way what is covered by a patent, then you are guilty of infringement. Whether you get caught is another story.

J. B. Ricketts: We follow that practice. Each week I collect the patents in the U. S. Patent Office Gazette that are of interest to our men and order enough copies to send to the mill men. They are to keep their hands off anything along that line without taking it up with the Patent Department; they are not to attempt in any way to take an undue advantage of someone else's patent. We must respect and honor the other men's patents is the way we feel about it.

Question No. 3—Suppose I make an improvement on a watch, place the watch with the said improve-

ment on the market with the back sealed, or suppose I carry on a use of an invention in a factory or mill over a period of months or years, behind locked doors, where visitors are not allowed to enter but where certain workmen engaged by me, work with the thing and practice the invention. Is either, or both, of these uses considered "public use"?

W. R. Coley: Both of them would be considered public use. A man made a new form of corset stay that was put on a corset worn by his wife (this was in the days when women wore corsets) and he swore that for the length of time the corset was worn, no one had seen the corset; but that was held by the Court as public use—no reflection or imputation on the character or reputation of the woman, either. The mere fact that she had it constituted "public use."

C. M. Vetter: A party filed application for a certain article and wanted to get us to use it and submitted a design to us. We did not like the design submitted, but worked on some of the ideas which may or may not have been patentable. The final result was something altogether different from his design, and we went ahead and had two of the articles constructed. One and one-half years from the time of filing his original application, after these new types were built, he filed another application covering our design. I was wondering whether he had a right to do that; and if a patent under these circumstances would be valid?

W. R. Coley: I would say not. If your modification or improvement constituted a suffiicent advance or was sufficiently distinct from his original idea so that the Patent Office would call it a distinct invention, he is not entitled to it. On the other hand, if a man has an idea and explains it in a general way to a draftsman, or says take this and work it up, the whole point there is, does he give him enough of an idea of the working parts to be constructed, or of which the article is composed. If he does, even though the first man did not put a thing down on paper, he would be the sole inventor. If he says, "I have been trying to work out so and so, and can't get this to do that; see what you can do with it." In that case it would be a joint invention; or if that particular thing would be the missing link, that might be the invention of the draftsman alone. If you took out a patent on your modification alone, the other man could not take out a valid patent on it.

Again, suppose a man has something he has worked up and goes to another man and says, "I want you to rivet these parts together." The other man suggests welding it. The substitution of one well-known means for another, as in this case, is not patentable. In general, you are entitled to a patent on your specific improvement, if it amounts to invention.

C. M. Vetter: Can he file the second application as an amendment to his first application?

W. R. Coley: There is no amendment of this sort to a new application. If you wish you can put two or more modifications of an invention in your original application. The Patent Office will allow broad claims covering both, but you must elect which species you will retain as the preferred form. The patent will issue with broad claims and with a set of claims specific to your preferred form. Then if you want to take out another patent on the second form, you should file an additional application. Before the first patent issues, file a second application on that. If you want to prove the date of invention for the second application, you can go back to the date of the original invention. You cannot add anything new to a patent application. To cover any new matter you have to file a new application. You can revise the drawing to conform to the description, or vice versa, but you cannot add something to both the drawing and description.

F. G. Boura: With the Westinghouse Company is the patent taken out in the name of the company or the engineers who develop the apparatus?

W. R. Coley: A patent to be valid in the United States must be filed in the name of the inventor or inventors, which means the persons, according to the rules of the Patent Office, who actually made the invention. What you have in mind is that, either before or after a patent is issued, it can be assigned to the Westinghouse Company, for example, but the patent will always be taken out in the name of the inventor himself. Most large companies which have engineers who are likely to perfect inventions and in whose line of duty it is to solve engineering problems, place them under contract to assign their inventions. All they receive, on the face of things, is $1 per assignment. Actually, their reward is taken care of in their salaries. If you are hired as an engineer by the Westinghouse Company, it wants the products of your brains as applied to its work. In England, a company can take out a patent in its own name, but not in this country. It is necessary to have personal signatures. If an inventor dies, his administrator makes oath.

F. G. Boura: Is it necessary for the designer to swear he developed the apparatus in question?

W. R. Coley: Yes.

J. B. Ricketts: Most of you gentlemen have Patent Departments in your organization, or are in close touch with patent attorneys on the outside. At the present time in Congress there are two bills by Mr. Vestal, one about patents and the other about trade marks; both very similar. I will give you a brief summary of what they contain: They provide for an increase in salaries of some of the Examiners and an increase in the number of Examiners, with the object of increasing the efficiency of our United States Patent System. But there is one little thing in each one of these bills which, to my way of thinking, will be very detrimental to all of us in the near future and for years to come, and that is something that will cause more court litigation respecting patents than we have had heretofore. The bills provide for the destruction of the patent file wrappers after twenty years. That means the Patent Office Records which are now down in the Patent Office stored away, and available, would be destroyed. Occasionally in Court practice, those interested get them out and look them over to see how good a patent is as you can tell just what it covers from its history. You can send your man down, look at the file wrapper, see what claims are made, see the arguments by the attorneys, the references cited, etc. Most patents give the history of the patent. It may be a patent on which you are going to rely in a Court case as to "prior art." In that

event, the file wrapper is of extreme importance. If we allow Congress to pass this bill and it becomes a law, this evidence will no longer be available. The trade mark bill has been passed, on April 7 of this year, and is now ready for signature. Can we not do something to stop the President from signing. It is wrong to destroy Patent Office Records. They could be stored away in some other building, if necessary, in Washington. It would not be an expensive procedure, if necessary, on account of the Patent Office being overcrowded for space. Certainly we should not allow Congress to go through with this thing and make a law out of it. In Court work—I believe Mr. Coley will bear me out—many times patents are used as "prior art" forty or fifty years old. There is no other way of getting the history of a patent as to whether or not it is prior art, unless we get the Patent Office Record.

In the case of trade marks, particularly, they should be retained, kept indefinitely; for the reason when you get a trade mark it is good for twenty years, and then you pay a small fee and get it renewed, and as long as kept alive over twenty years you have a trade mark. You do not want to stop the use of a trade mark; if you get into litigation, all you have is twenty years' history if this goes through. What shall we do about it? I have written 15 or 20 letters myself; have written to the Representative from our district in the House of Representatives; it was handed to another member, who did not even read the letter. The Bill had been passed by the House of Representatives, and referred to the Committee on Patents in the Senate. The party addressed did not read it to any of the Senators or talk to them personally about it. I know what is back of the whole thing. There is a class who want to get rid of the Patent Office Records; it means more work for them.

J. F. Kelly: Suppose I was an employee of a steel plant and used the company's time and money to perfect a patent, what rights do I enjoy, and what rights does the company enjoy?

W. R. Coley: If you are under contract and have assigned your inventions, you have no further rights. But if not under contract, then you can take out the patent in your name and it will belong to you, with this exception: If you use the facilities and time of the company you are working for to develop a certain invention, then that company will retain so-called "shop rights" to continue to make and use that particular scheme at least for their own purposes. There is some difference of opinion as to whether they could go ahead and sell, but, at least, they can use it for their own purposes. But you will be entitled to take out the patent in your own name and sell rights to others. That is the reason why large companies have their engineering representatives under contract.

F. G. Boura: If a man is under contract and he works at home or elsewhere on entirely different work, can this be claimed by the party to whom he is under contract?

W. R. Coley: That depends. We feel that inventions made by any of our engineers along the lines we are in, belong to the company. On the other hand, if you are employed by the Westinghouse Company and make an invention on a cork screw, they would not be entitled to that; that is out of their line. If an engineer makes an invention in radio, even though he is not working in an electrical engineering department, then it belongs to the company. The theory is that if you were not working on this job, you would not have thought of that invention. Most companies, when they employ the services of an engineer, want the products of his brains if related to their line of work.

K. Feller: Suppose I manufacture a patented machine, what inscription must be made on the name plate or otherwise by requirements of the law?

W. R. Coley: At the present time, if the patent has been recently issued (since April, 1927) all you need to put on is the word "Patented" and the patent number.

K. Feller: Not the name of the manufacturer?

W. R. Coley: No. Anything else you want, but all you need is "Patented," with the number. If the patent was issued prior to April, 1927, either the number or the date is permissible. When you see name plates corresponding to earlier patents you will see a string of dates, but all that is necessary at present is as just stated.

Wm. P. Spielman: There is another bill in Congress in addition to the ones that we have commented on to which I would like to call attention, the Dill Bill (Senate Bill 4442). This bill provides in effect that if you own a patent and bring suit under that patent the defendant can plead in defense that you are violating the Anti-Trust laws. This defense is something entirely new, and is entirely extraneous from the other logical defenses that are permitted in a patent suit. The question whether you are violating Anti-Trust laws does not seem to have much to do with the patent at all. It is perhaps a sporadic growth of trust busting ideas; and while I do not know a great deal about politics, I would like those here to consider this bill in connection with the other pending litigation that has been presented, and if there is any action taken I would like to have such action include this bill also.

R. F. Waldo: In the example the gentleman used; of the bi-metallic disc—presuming that it is prior art and for years it has been generally known that two dissimilar metals joined together—welded or rolled together—will distort under temperature; could you then take out a patent on a special use of an already known art? You have used a bi-metallic strip for cutting off current. Could someone else take that same bi-metallic strip; use it for another purpose, and get a patent on it?

W. R. Coley: That particular disc as I recollect is the first bi-metallic structure which gives you a quick snap in both directions. I think that is the first one, and although you are using an old idea of bi-metallic principles you have a new result. If I understand your question correctly, we have applied this to an iron. We have a patent out on that general point which will cover other switching apparatus, but we could not take out one patent for using that particular disc in an iron and another in a steel mill. Even if the elements you use are old in themselves, if you put your elements together in a new way and that gives you some new result different from what anybody has achieved before, you are entitled to a patent. The only reason you can get a patent

involving the use of an old bi-metallic device is if you are getting a new result.

R. F. Waldo: Suppose one wanted to shut off steam by that means—could he get a patent on your idea?

W. R. Coley: Possibly they could if it required, in the eyes of the Patent Office any invention to adapt it to that particular use, or whether, in its opinion, you have a combination not obvoius to anyone as a mere substitution of one well-known element for another. As an example, take systems for starting direct current motors. All you have is a motor, resistance, a couple of switches and something to control those switches. All you have is those four elements, but there are thousands of patents that have to do with those four elements. The novelty resides in what you use to control the switches. That is why patents are continually being issued on control systems that use the same elements. The whole point is if you have got sufficiently far away from prior schemes, in the eyes of the Patent Office, you have an invention. A famous case is where a printer took the well-known spring inside of a shade roller and applied the idea to an ink roll in a printing press. It was so much larger and the application was so different that the Patent Office ruled it required inventive thought to apply it to this new use, so they gave him a patent. The whole thing is a matter of opinion.

W. C. Buske: How soon after patents are issued, can you secure a copy from the Patent Office?

W. R. Coley: Patents issue every Tuesday and and you can get copies immediately or at any later time for ten cents apiece.

J. S. Rashba: The real patent on the disc is the quick reversal of the disc?

W. R. Coley: The distinctive feature in the disc itself is in shutting the current to an iron on or off, by a snap action. I would say you could build an iron with some kind of automatic features that would not infringe this patent, but if you had something that had a quick make and break, you probably would run into that patent.

E. A. Hurme: Is it not a fact that a great many of the inventions made today are the result of engineering efforts applied to daily work, and not many arbitrarily produced by a man sitting down to make an invention?

W. R. Coley: I do not know what the percentage is, but I would say the big majority of patents are the result of serious inventive thought on the part of people who are engaged in their daily work. As I recollect it now, the Westinghouse Company takes out about two percent of all patents issued in the United States. But there are a great many frivolous patents taken out on such things as non-refillable bottles, monkey wrenches, and so forth.

E. A. Hurme: Is it not a fact that a great majority of the inventions result from the efforts of engineers engaged in their daily work.

W. R. Coley: Undoubtedly 95 percent are the result of problems put up to them. There are very few fellows who sit down and have a "brain flash." The engineers don't look like inventors, most of them. They are fellows who work things out in the course of their daily task.

C. E. Bedell: I have enjoyed this meeting very much. Most of the fellows would like to realize on their patents, but from the trend of the meeting and from remarks we have heard, it would seem it is something like working the stock market; if it goes up you win; if it goes down, you lose.

Is it possible for a man to get a patent on an apparently good idea that describes the idea and process, describes the ways and means of accomplishing the result, makes certain claims, but possibly never done any of the work necessary to accomplish those claims. Although it might work, it might not. It looks possible, but has never been accomplished. Does that stand as a valid patent; whether or not? Would that be considered a valid patent?

W. R. Coley: If a device of that sort is put through, you get what we attorneys call a "paper patent"—one that has never been built. If that device will work it does not make much difference, however. It is a perfectly valid patent as regards holding others from infringing, or as an anticipation of a later invention. But if it becomes necessary for you to prove your claims, the defense may point out that this thing works only on paper, that it is merely a paper invention. For instance if a wheel is supposed to rotate all the way around, and there are a couple of arms in the way, that patent will be thrown out. But if you have something that will work, no matter how crude or how out of proportion; if it can be built so that it will support your claim, that patent is good. If you have built the thing and have it running and have established certain equities, the average judge will consider you have a real patent. But on the other hand, if you have never built your device, your patent may be good, but he may decide to give the other party the benefit of the doubt.

C. E. Bedell: How many people put in applications for inventions on perpetual motion?

W. R. Coley: Plenty. But it is handled a little differently. The Patent Office writes that they are unable to understand the invention, and if the inventor will send a model they will proceed, or, failing that, they offer to return the Government fee. That is all that is necessary in such cases.

You are all familiar with "Rube" Goldberg's cartoons. The Patent Office is filing those away. "Inventors" at times work up some sort of devices along those lines, but they constitute prior publication and are just as good as anything else for knocking out a patent.

W. P. Spielman: I might add a little explanation on how the Patent Office handles perpetual motion claims. They reply to the inventor that the Patent Office has never been convinced that perpetual motion is possible, consequently the applicant has the option of accepting his fee back or submitting a working model.

President's Report A. I. & S.E.E. 1929-1930

Today, Monday June 16th, 1930, marks the 26th meeting of the National Body of the Association of Iron and Steel Electrical Engineers.

We, as an association have much to be grateful for, from a very humble beginning, small in numbers, but resolute and firm in purpose, we have established ourselves, as a body, a society, of engineers, executives, with 25 years of experiences in the advancement of the application of electricity and other forms of engineering to the Iron & Steel Industry and Allied Industries.

Our accomplishments are in the past, our future, is before us. As engineers and executives in the Iron & Steel Industry, we have accepted the responsibilities for the future programs and problems to be undertaken. Modernizing our plants, is the task which lies ahead of us, there is plenty of work to be done.

A few years ago, it was felt that in probably ten years most of the steel plants in the United States would be completely rehabilitated, however, with the advances being made in metallurgical and engineering practices today, it now seems that rehabilitation will be something akin to perpetual motion. A modern rolling mill placed in operation today will be struggling for existence in the next four years.

Electrical Welding will make obsolete in a short time, many modern installations of today.

The twin motor drive for large rolling mills, now in its cradle clothing, will soon be in operation. Magnetic Control, the essence of everything electrical, is slowly but faithfully, making work easier for mankind.

Three hundred ton ladle cranes are on the threshold.

What has our Society to do with all of this progress?

What action must we take in the program of the future?

It would be my recommendation that our Association continue its intensive collection that distribution of matter and data pertinent to engineering practices concerning the development of all classes of apparatus used in our industry.

It is true that in our Association's engineering files, we have twenty-five years experiences of the men in the field of operation. There must be no letdown, the members must continue to contribute in the future as they have in the past.

Our Society has established itself as the engineering authority of the Iron and Steel Industry, by its work and accomplishments, and these heritages, are being handed down to courageous, ambitious successors, who will also labor to spread the lights and the truths of this great society.

It is now my pleasure to report to you, the results of the stewardship you entrusted me with one year ago today.

Meetings

Last year, each and every section enjoyed a successful year.

The attendance at the various meetings indicated that the officers of the Sections were providing programs and papers of interest. Our attendances ran as high as one thousand at a section meeting.

District Sections

As President of the Association of Iron and Steel Electrical Engineers, I wish to take this opportunity to thank the officers of all of our District Sections for the splendid co-operation they extended their respective sections as well as the National body.

After all, the success of the district sections makes for the success and prosperity of the National Organization.

Papers

About 75 papers were presented before the various sections and the National Body during the last year. These papers had to do with electrical, combustion, mechanical and metallurgical practices.

National Committees

All of our National Committees functioned splendidly during the last year, and again I wish to convey my sincerest appreciation for this co-operation.

The Special Committee on Bearings during the last two years have been especially active and the results of this committee's work will be of material assistance to the man in the field.

The Electric Heat and Welding Committee plans another National Conference to be held in Pittsburgh, November 18th-19th, 1930. They are to be congratulated on their last National Meeting held November 1929.

The Shop Practice Committee has a very able report to be presented this morning. This report is of interest to every operating superintendent and engineer.

The Electrical Development Committee, as usual, presents today a comprehensive outline of the progress made in our industry.

The Standardization Committee in 1930-31 will develop something in connection with standardized control.

The Illumination Committee is presenting a paper here this morning by Mr. R. F. Sanner. They are to be congratulated on the very complete paper they are presenting before the Association.

Our papers committee, our editing committee and our membership committee have all co-operated splendidly and the results speak for themselves.

Iron and Steel Engineer

The IRON AND STEEL ENGINEER, which all of the engineers of the Iron and Steel Industry feel is the engineering authority of our industry, has assumed its rightful place among the leading scientific and technical periodicals. Every member of the Association and every engineer in the iron and steel plants should feel proud that they are represented so fully and completely in the engineering

(Continued on Page 401)

The Use of Mixed Gas (Blast Furnace and Coke Oven Gas) on Open Hearth Furnaces at Wisconsin Steel Works †

By GEO. E. ROSE and F. M. WASHBURN*

In the Fall of 1927, when we were considering the building of a new Blast Furnace and an additional Battery of By-Product Coke Ovens, we were confronted with the problem of making efficient use of the Surplus Blast Furnace Gas and the Surplus By-Product Coke Oven Gas in our Steel Plant operations.

We had heard of the use of Mixed Gas (Blast Furnace and Coke Oven Gas as the Fuel for Open Hearth Furnaces in Germany, and inasmuch as we were buying Fuel Oil for the operation of our Open Hearth Department. we began experimenting with the use of a mixture of these Gases on one of our Open Hearth Furnaces in March, 1928, and have continued with gradually improved results until the present time, and now we feel we have developed a satisfactory prototype of Open Hearth Furnace and of Open Hearth Practice for the use of these Mixed Gases in our plant.

We started our experiments with Mixed Gas on our #1 Open Hearth Furnace, which originally had been built for Oil Firing. A Division Wall was built in the Slag Pockets which had been common to the two Checker Chambers on each end, and a brick Gas Port was installed, having a length of 6'9" and an area of about 6 sq. ft., with slight water cooling by means of pipes. The Checkers used were the same as used on the Oil Furnaces, 13¼" x 4½" x 4½", laid with 9" openings. The same Water Cooled Slide Valves were used for reversal as had been used with the Oil Firing and the Mixed Gas was introduced between these Valves and the Checker Chambers.

The Mixed Gas Campaign on this Furnace was started on February 27, 1928, with Oil Firing for warming up the Furnace, and we continued to make Steel with Oil until March 10th. From March 10th to May 10th, a period of two months on Mixed Gas, we obtained the following results:

#1 Open Hearth Furnace—First Campaign on Mixed Gas

(1) Fuel Practice—7,926,561 B.T.U. Per G. T. of Ingots.
(2) Preheat Temperature in Mixed Gas—1,735° F.
(3) Preheat Temperature in Air—1,935° F.
(4) Average Stack Temperature—1,250° F.
(5) Ratio of Blast Furnace Gas to Coke Oven Gas by Vol.—1.76 to 1.00.
(6) Heats—89
(7) Ingot Tonnage—9,851 G.T.
(8) Blast Furnace Gas = 90 B.T.U. Coke Oven Gas = 582 B.T.U. Per Cu. Ft.
(9) Percent of Hot Metal in Charge—35.6%.
(10) Percent of Steel Scrap in Charge—64.4%.
(11) Average Size of Heat—111 G.T.

The operation of the Furnace during the First Campaign on Mixed Gas was far from satisfactory. We endeavored to operate on an average ratio of 2 to 1 of Blast Furnace and Coke Oven Gas, using a richer mixture during the melting-down period and a leaner mixture after the hot metal addition. This ratio proved to be too lean and could not be maintained, as when operating on this mixture, the bath would freeze on the incoming end while thawing on the outgoing end.

The flame did not have sufficient velocity due to the large Gas Port area and was lazy and sluggish. This caused the Furnace to work slowly, particularly during the melting-down period, and therefore the fuel consumption was high. The nose of the Gas Port was burnt off after 35 Heats, deflecting the flame hither and thither through the cooling pipes. We tried to keep this in control by plastering Chrome Ore on the sparsely laid net work of cooling pipes in the port construction, but we were not able to continue the operation of the Furnace on Mixed Gas beyond 89 Heats.

From May 10th to July 10th, the Furnace was thrown back onto Oil on account of the Ports being burnt out and impossible to maintain while the Roof and Checker Chambers were good for as many Heats or more as already had been made on the Mixed Gas.

From July 10th to July 30th, the Furnace was rebuilt with many changes. The Gas Ports were nozzled down to an area of 3.28 sq. ft. and built of brick, but with much more extensive water cooling than on the First Campaign. The passages for Air also were narrowed down, and a Sloping Backwall was installed. There was also considerable insulating done on the Checker Chambers and Slag Pockets. Single-Pass Checkers were used, built of standard 9" brick.

When the Furnace was started up on this Campaign with the Nozzled-Down Gas Ports, the mixture of Blast Furnace and Coke Oven Gas lit up considerably over the Gas Checker Chambers. We, therefore, plastered over the Sides and Roof of the Gas Checker Chambers with a Combination of Molasses, Fire Clay, etc., so as to stop most of the leakage.

On this Campaign, with Mixed Gas—from July 30, 1928 to January 18, 1929—we obtained the following results:

#1 Open Hearth Furnace—Second Campaign on Mixed Gas

(1) Fuel Practice—5,751,070 B.T.U. Per G. T. of Ingots.

* General Superintendent and Chief Chemist.
† Presented at 26th Annual A. I. & S. E. E. Convention, June, 1930.

(2) Preheat Temperature in Mixed Gas—1,761° F.
(3) Preheat Temperature in Air—1,836° F.
(4) Average Stack Temperature—1,086° F.
(5) Ratio of Blast Furnace Gas to Coke Oven Gas by Vol.—1.96 to 1.00.
(6) Heats—345.
(7) Ingots—42,457 G.T.
(8) Blast Furnace Gas = 90 B.T.U. Coke Oven Gas = 582 B.T.U. Per Cu. Ft.
(9) Percent of Hot Metal in Charge—40%.
(10) Percent of Steel Scrap in Charge—60%.
(11) Average Time Per Heat—11:58.
(12) Average Size of Heat—123 G.T.

From the above you will note that we made a fairly creditable run or Second Campaign on this Furnace with Mixed Gas. The much smaller Gas Port area during this campaign gave better direction and greater velocity to the flame. The Furnace worked faster, particularly during the melting-down period. After about 30 Heats the Ports started to cut out, slowing up and deflecting the flame. An endeavor was made to maintain original port size and contour, but it was impossible. After about 150 Heats the Furnace was shut down and the Port was bricked up to original condition.

Although we were doing pretty well with Mixed Gas, it was not as good work as Mr. Rose had been privileged to observe in Germany a few months before on a similar gas mixture, where they were averaging about 4,800,000 B.T.U. per G. T. of Ingots for a year's run on an Open Hearth Shop.

We, therefore, set ourselves the task of figuring out and deciding upon what changes for improvement we could make in the present campaign or on the next rebuild in the light of our observations in Germany.

We installed about the middle of this, the Second Campaign, a Fan on the Air and an Automatic Regulator for keeping the Air in proper proportions to the varying quantities of the Gases used at different periods of the Heat, similar to the installations in Europe. After the installation of the Fan on the Air, a distinct improvement in the sharpness of the flame was noted.

On the next rebuild—February 6 to February 27, 1929—for the Third Campaign, we made no changes in the Furnace above the Charging Floor (you will recall we had the Special Ports as described and Sloping Backwall on the previous campaign.) We did, however, make three major changes below the Charging Floor. First, we encased the Gas Checker Chambers in ¼" Steel Plates and the Slag Pockets in ⅜" Steel Plates, filling in between the Plates and the Insulated Brickwork, a space of 4" to 5", with dry sand. Second, we used smaller Checkers, 9" x 4½" x 2½", laid with 6½" x 6½" openings, in both the Gas and Air Chambers, arranging them so as to give us two correct passes, that is, downward through the Checkers for the Exhaust Gases, as observed by Mr. Rose in Germany, and as indicated by sketches and described in Book by A. D. Williams as used in the Plant of the Pennsylvania Steel Company many years ago. Third, we installed a Water Sealed Valve for Gas Reversal in place of the Slide Valves, which in our case had been put in for handling Air on Oil-Fired Furnaces. In our endeavor to eliminate as many unknown quantities as possible, we decided upon a Water Sealed Valve, but have had some leakage between the Valve Base and the Brickwork of the Flues, which required regrouting or tamping.

The Furnace, rebuilt as above for its Third Campaign on Mixed Gas, was started up on February 27, 1929, and was taken off on September 15, 1929 (a period of 6½ months), having given the following results:

#1 Open Hearth Furnace—Third Campaign on Mixed Gas

(1) Fuel Practice—4,989,710 B.T.U. Per G.T. of Ingots.
(2) Preheat Temperature in Mixed Gas—1,808° F.
(3) Preheat Temperature in Air—2,006° F.
(4) Average Stack Temperature—922° F.
(5) Ratio of Blast Furnace Gas to Coke Oven Gas by Vol.—1.99 to 1.00.
(6) Heats—382.
(7) Ingots—48,243 G.T.
(8) Blast Furnace Gas = 90 B.T.U. Coke Oven Gas = 582 B.T.U. Per Cu. Ft.
(9) Percent of Hot Metal in Charge—33.5%.
(10) Percent of Steel Scrap in Charge—66.5%.
(11) Average Time per Heat—12:27.
(12) Average Size of Heat—126 G.T.

These results show that the changes made on the last rebuild were real improvements. Our B. T.U. Consumption Per G.T. of Ingots (4,990,000) is now getting down pretty close to the German figure. The tightening up of the Furnace, by insulating and encasing in Steel Plates both the Slag Pockets and the Checker Chambers, together with more effective use of the checker space, by the two-pass checker system, seemed to give results, as you will note, by way of higher Preheats and lower Stack Temperatures. However, we couldn't get as high Preheat in the Mixed Gas as we would like to have had, due to the small Gas Port exit.

Our greatest difficulty on this campaign was the burning down of the Ends of the Furnace, requiring a shut-down about every three weeks for bricking up the Bulkheads. It was necessary to stop the Furnace several hours for brickwork eight different times during the first 226 Heats, and then it was necessary to take the Furnace off for two days, when both Ends of the Furnace, 2½ ft. above the Floor Level, were rebuilt, the Gas Ports repaired and a new Roof put on each End of the Furnace over the Uptakes and Gas Ports.

COMPARATIVE STATEMENT OF COST OF BRICK REPAIRS FOR FIRST 266 HEATS ON THIRD CAMPAIGN WITH OIL-FIRED FURNACES OPERATING SIMULTANEOUSLY FOR ABOUT THE SAME NUMBER OF HEATS

	Fce. No.	Fuel	Material	Labor	Material & Labor	No. of Heats	Tons	Cost Per Ton
Third Campaign	1.	Mixed Gas	$3,842.41	$1,673.37	$5,515.78	266	33,842	$0.1629
	5.	Oil	1,489.10	656.20	2,145.30	312	37,943	.0565
	7.	Oil	1,668.13	778.10	2,446.23	393	47,557	.0514

This Refractory trouble was due to the comparatively narrow passages around and over the top of the Gas Port in the Special Port construction, creating extremely high velocities of the hot exhaust gases against which we could get no brickwork to stand up. In view of this difficulty, and in view of the fact that we couldn't get sufficient Products of Combustion back through the small Gas Port Opening (a requisite for the Burning End of the Furnace, but a detriment to the Exhaust End) to get the Preheat in the Mixed Gas up to the Temperature of Dissociation, which was emphasized so strongly in Europe as a requisite for best results with Mixed Gas, we decided to make a trial of the so-called Movable or Disappearing Port as indicated by the sketch in Fig. I.

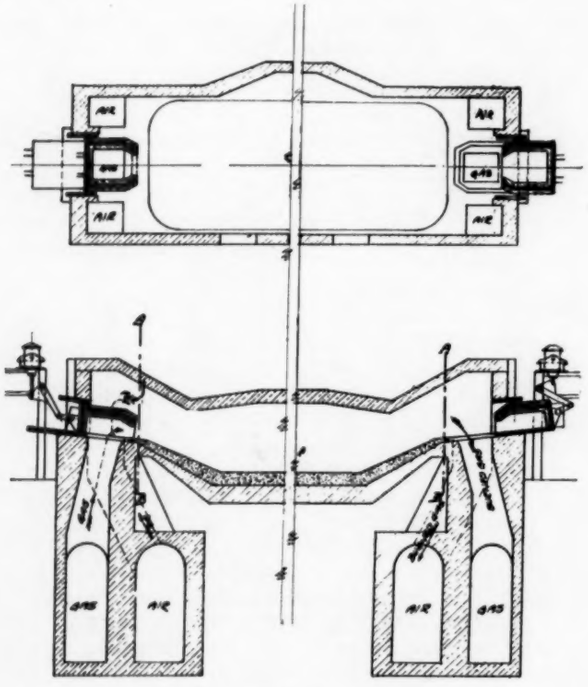

FIG. 1.

You will note the Port on Reversal disappears from the path of the Outgoing Products of Combustion, thereby giving what ordinarily would be called an Open-End Furnace, slowing down the velocity of the hot burnt gases in the very Ends of the Furnace over the Downtakes, but not at a point or a cross-section of the Furnace corresponding to the point where the Gas and Air meet on the Burning End of the Furnace. This Open-End Furnace, as it were, with the full opening of the three Downtakes effective, makes it possible, by means of the Slide Valves in the Flues, to get any division desired of the Products of Combustion between the Gas and Air Checker Chambers. This predetermined or correct division of the Waste Gases between the Regenerators is possible with the above construction with a very moderate stack draft differential, whereas, with the Nozzled-Down Gas Port in the Furnace on the Outgoing End, there is a tendency to use a high draft differential in an attempt to suck enough Exhaust Gases back through the Nozzled Gas Port with the high draft effective on the Gas, and throttled on the Air, and thereby make an excessive draft pull effective on all the Checker Chambers and Flues to the end of increasing the tendency to explosions on Reversals, a more or less inherent characteristic of all Regenerative Furnaces.

We reverse by first shutting off the Coke Oven Gas with a Quick-Closing Valve. In 45 seconds the operator throws over the Control on the Gas-Reversing Valve, and the Air, being electrically connected with the same Control, is automatically reversed in 20 seconds thereafter. The Coke Oven Gas is turned on the other end as soon as the Gas-Reversing Valve is over. The Movable Ports are reversed simultaneously, one pulled out and the other shoved in, immediately after the Reversing Gas Valve is over, i.e., during the period the Gas and Air Checker Chambers are filling up on the other end. You will note this requires just a little over a minute to reverse the Furnace completely.

In this way, too, you will observe on Reversals, we pull back up the stack only a Checker Chamber full of Blast Furnace Gas, a considerably less B.T.U. quantity than in the case of reversing a Gas Producer Furnace.

Our experience with "kicks" or slight explosions on Reversals has been negligible, especially since using the Movable Ports and operating on a much lower draft differential. Our Melters and First Helpers report that our Mixed Gas Furnaces are quieter and smoother on Reversals than is customary with Producer Gas Furnaces. In fact, we go along for days and weeks without the slightest puff on reversal and for several months we haven't had a "kick" that caused the slightest disturbance.

Getting back to the No. 1 Furnace, it has made a total of 382 Heats on its Special Port construction for the Third Campaign on Mixed Gas. The Ends required rebuilding again, the Slag Pockets had become so filled up with melted down bulkheads that they were choking off the Checker Chambers, so the Furnace was shut down for five days during which time the Slag Pockets were partially cleaned out, Front Wall and Roof renewed, Ends bricked up anew, and the Movable Ports installed, but without touching the Checkers at all, the Furnace was put back on for its Fourth Campaign on Mixed Gas on September 22, 1929. It ran until March 22, 1930, making 354 Heats with the Movable Ports and 736 Heats without cleaning the Checkers. It was forced down due to the first pass of the Air Checkers choking up, although the Roof was in such good condition after 354 Heats that it has not been renewed for the next campaign and the Ends of the Furnace were in good condition, never having had more than a few bricks renewed during the campaign of making 354 Heats.

COMPARATIVE STATEMENT OF COST OF BRICK REPAIRS DURING THE THIRD CAMPAIGN WITH SPECIAL PORT CONSTRUCTION AND THE FOURTH CAMPAIGN WITH MOVABLE PORTS

Special Brick Port Construction

	Fce. No.	Fuel	Material	Labor	Material & Labor	No. of Heats	G.T. Prod.	Cost Per Ton
Third Campaign	1.	Mixed Gas	$5,263.31	$3,193.43	$8,456.74	382	48,243	$0.175
Time down for Brickwork Repairs—191 hours and 20 minutes.								

Movable Ports

Fourth Campaign	1.	Mixed Gas	$ 325.32	$ 117.38	$ 442.70	354	44,840	$0.0099 i.e., 1 Cent Per G.T.
Time down for Brickwork Repairs—10 hours and 45 minutes.								

$0.175 As Per Third Campaign
$0.010 As Per Fourth Campaign

Difference $0.165 Saved in Brick Repairs Per G.T. With 48,243 G.T. of Ingots for Third Campaign x $0.165 = $7,960.10 that would have been saved if the Movable Ports had been used on the Third Campaign in place of the Special Port Construction.

Following are the results of the Fourth Campaign on Mixed Gas with the Movable Ports:

#1 Open Hearth Furnace—Fourth Campaign on Mixed Gas

(1) Fuel Practice—4,518,560 B.T.U. Per G.T. of Ingots.
(2) Preheat Temperature in Mixed Gas—1,996° F.
(3) Preheat Temperature in Air—1,666° F.
(4) Average Stack Temperature—921° F.
(5) Ratio of Blast Furnace Gas to Coke Oven Gas by Vol.—2.03 to 1.00.
(6) Heats—354.
(7) Ingots—44,840 G.T.
(8) Blast Furnace Gas = 90 B.T.U. Coke Oven Gas = 582 B.T.U. Per Cu. Ft.
(9) Percent of Hot Metal in Charge—36.4%.
(10) Percent of Steel Scrap in Charge—63.6%.
(11) Average Time Per Heat—12:09.
(12) Average Size of Heat—127 G.T.

You will note the Preheat in the Mixed Gas is almost 200 degrees higher in the Fourth Campaign with the Movable Ports than in the previous campaign (1,996 — 1,808 = 188 degrees). To this higher Preheat in the Gas and to the fewer stoppages for brick repairs we attribute the better fuel practice, 471,000 B.T.U. less required per gross ton in the Fourth Campaign, than in the Third. You will note that we got the Preheat up in the Gas at the expense of the Preheat in the Air as compared with the Third Campaign, viz:

	3rd. Campaign	4th. Campaign
Gas Preheat	1,808	1,996° F.
Air Preheat	2,006	1,666° F.
Stack Temperature	922	921° F.

This was possible by means of the Movable Ports, giving us an Open-End Furnace, in conjunction with the Slide Valves, with which we could make any division we wanted of the Products of Combustion between the Gas and Air Checker Chambers. On account of the Checkers having been used for a previous campaign, we couldn't get the Gas Preheat up except at the expense of the Air. This reduction of 471,000 B.T.U. Per Ton on the Fourth Campaign shows the importance of getting the Preheat into the Gas even at the expense of the Preheat in the Air. However, you will see later on in the results of the First Campaign with Movable Ports on #2 Open Hearth Furnace with new checkers where we get a Gas Preheat of 2,013° F. and an Air Preheat of 1,817° F. with a Stack Temperature down to 840° F.

The 2,000° F. Preheat that we show in the Mixed Gas is not as high as it should be for best Heat Transmission according to the Laboratory Experiments of Dr. Bansen of the Krupp Steel Works, results of which experiments are shown on the Curves in Fig. 2.

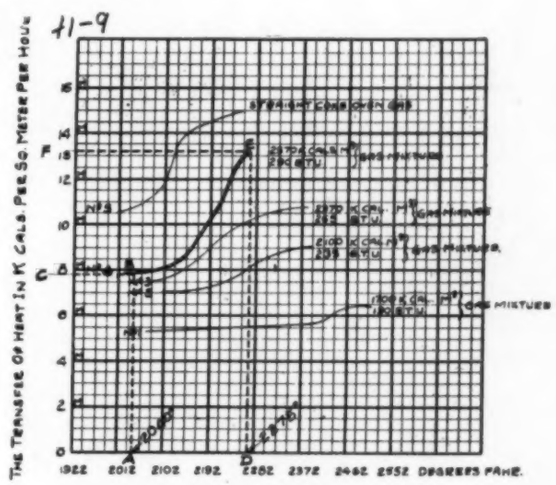
41-9
THE TRANSFER OF HEAT IN K. CALS. PER SQ. METER PER HOUR
TEMP OF PREHEAT IN GAS IN DEGREES FAHR.
1922 2012 2102 2192 2282 2372 2462 2552 DEGREES FAHR.
A
D
GAS MIXTURES

FIG. 3 TRANSFER OF HEAT FROM THE BURNING OF PREHEATED GAS TO COLD WALLS; I. E., SHOWING THE EFFECT OF THE PREHEATING OF GAS UPON THE TRANSFER OF HEAT FROM THE FLAME IN AN OPEN HEARTH FURNACE

EXPERIMENTS AND CURVES BY DR BANSEN OF THE KRUPP STEEL WORKS

NOTE THE GREAT INCREASE IN HEAT TRANSFER IN CURVE NO 4 WHEN THE PREHEAT IS RAISED FROM 2040° FAHR. TO 2275 FAHR THE INCREASE IS FROM 8 TO 13 OR ABOUT 65%

FIG. 2.

The Temperatures on the Gas Preheat that we show were taken in the top of the first pass of the Gas Checker Chambers, out of the current of the Incoming Fuel Gas, as we couldn't maintain Thermo-Couples in the gas current, in the necks between the Slag Pockets and Checker Chambers. Portable

Pyrometers with fire ends in the necks between the Slag Pockets and Chambers, on a number of tests, showed an average Gas Temperature of 138° F. higher than the stationary instruments at the same time. However, we got considerable cracking up of the hydro-carbons in the Coke Oven Gas as shown by the following analyses, and our actual temperatures on Mixed Gas, perhaps more nearly approached the 2,200° F. as shown to be desirable by Dr. Bansen's Laboratory Experiments:

Gas Analyses

	CO_2	Ill.	O_2	CO	H_2	CH_4	N_2	
Fuel Gas at Main	11.46	1.67	.21	17.42	17.76	11.27	40.20	Average 18 Samples
Fuel Gas at Bulkheads	6.28	.48	.28	24.25	22.12	5.49	41.03	Average 18 Samples

The decreased amounts of illuminants and methane and the increased amount of hydrogen show the effect of the high temperature in breaking down the hydro-carbons to hydrogen and carbon. The decreased amount of CO_2 shows that a reaction has taken place between the liberated carbon and the CO_2 present in the gas, with the production of CO which is correspondingly increased.

The amount of carbon liberated by the cracking reactions is surprisingly large. In the case of the Heat on which the above analyses were obtained, calculations show that a total of 5,660 lbs. of carbon were liberated during the course of the Heat. This carbon exists in a very finely divided state and is carried up with the gas, imparting luminosity to the flame in the furnace.

A positive proof of the dissociation of the Coke Oven Gas is the intense luminosity of the flame, plainly visible to anyone observing the working of the furnace. The luminosity, and hence the transfer of heat by radiation, is greater than in any of our Oil-Fired Furnaces or than in a Gas Producer Furnace.

We believe that, although good work may be done, the best work cannot be done without the radiant heat from a luminous flame in an Open Hearth Furnace. The heat transferred by a luminous flame, traveling along immediately above the bath, is one of the best means of heat transfer in an Open Hearth Furnace, and it cannot be neglected and yet get the best results. It saves the Roof and the heat lost by excessive radiation from the Roof.

"The intensity of heat radiation from a given source varies inversely as the square of the distance from the source," hence, the advantage of the nearness of the Luminous Flame to the Bath as compared with the Roof from a radiation point of view. It should be remembered, also, that Lamp Black, Molecular Carbon, as produced by the cracking up of the Coke Oven Gas, is one of the best radiating substances known to science.

Heat transmitted by radiation differs from heat transmitted by conduction or by convection, in that the transfer by radiation is proportional to the difference between the fourth power of the absolute temperature of the radiating substance and the fourth power of the absolute temperature of the recipient substance, while the transfer by conduction or convection is proportional to the difference in temperature.

In other words, the transmission of heat by conduction or convection is the same from a body at, say, 1,000° F. to a body at 800° F., as it is from a body at 3,000° F. to a body at 2,800° F. since the temperature difference is the same, i.e., 200° F. The amount of heat transmitted by radiation would be very much greater in the second case than in the first, since it is proportional to the difference between the fourth powers of the absolute temperatures. In the examples given above, approximately fifteen times as much heat would be transmitted by radiation due to the same 200 degrees difference in temperature in the 3,000 degree Zone than in the 1,000 degree Zone. In addition, it is generally conceded that a luminous flame radiates heat from all parts of its volume, and that a hot, solid body radiates heat only from its surface.

Our experience with Mixed Gas would indicate that not too lean a mixture is best at first, during the Charging Period of the Heat, and then a slightly richer mixture during the Melting-Down Period, and latterly, during the Working Period and Finishing of the Heat, a less volume of both Blast Furnace and Coke Oven Gas, and perhaps a slightly leaner mixture towards the end is best, as shown by a comparison of results in January with February, this year, on our #1 Furnace, as follows:

During the month of January, the following gas ratios were used:

		Avg. Length of Time About
(1)	50,000 Cu. Ft. Per Hr. Coke Oven Gas 180,000 Cu. Ft. Per Hr. Blast Furnace Gas	While charging and until doors were banked. 2:34
(2)	60,000 Cu. Ft. Per Hr. Coke Oven Gas 160,000 Cu. Ft. Per Hr. Blast Furnace Gas	From time doors were banked until hot metal addition. 2:51
(3)	70,000 Cu. Ft. Per Hr. Coke Oven Gas 120,000 Cu. Ft. Per Hr. Blast Furnace Gas	After hot metal addition and up to time the Heat was well started boiling on Lime. 3:30
(4)	60,000 to 35,000 Cu. Ft. Per Hr. Coke Oven Gas 120,000 Cu. Ft. Per Hr. Blast Furnace Gas	From this point on, the Cu. Ft. Per Hour of Coke Oven Gas was reduced as often and as much as the temperature of the Heat would permit. 2:47

JANUARY	
Average B.T.U. Per Ton of Ingots	**4,529,170**
Number of Heats tapped	60
Tonnage made	7,787 G.T.
Time Charging Scrap	2′ 04″
Time from Charge to Hot Metal	5′ 25″
Time from Charge to Tap	11′ 42″

FEBRUARY	
Average B.T.U. Per Ton of Ingots	**4,080,000**
Number of Heats tapped	60
Tonnage made	7,755 G.T.
Time Charging Scrap	1′ 58″
Time from Charge to Hot Metal	4′ 55″
Time from Charge to Tap	10′ 34″

During the month of February, the following gas ratios were used:

			Avg. Length of Time About
(1)	60,000 Cu. Ft. Per Hr. Coke Oven Gas 150,000 Cu. Ft. Per Hr. Blast Furnace Gas	While charging and until scrap charge was well heated.	1:58
(2)	70,000 Cu. Ft. Per Hr. Coke Oven Gas 150,000 Cu. Ft. Per Hr. Blast Furnace Gas	After scrap charge was well heated up and until Heat was well started on Lime.	5:00
(3)	60,000 Cu. Ft. Per Hr. Coke Oven Gas 125,000 Cu. Ft. Per Hr. Blast Furnace Gas	After Heat is well started on Lime and until a further cut in temperature is required.	1:00
(4)	50,000 Cu. Ft. Per Hr. Coke Oven Gas 100,000 Cu. Ft. Per Hr. Blast Furnace Gas	When the temperature of the Heat requires the further cutting of Fuel Gas, the Blast Furnace Gas is cut to 100,000 Cu. Ft. Per Hr. and held constant for the balance of the Heat with the Coke Oven Gas varying as required for the proper temperature in the finishing of the Heat.	2:36

#2 Open Hearth Furnace With Movable Ports on Mixed Gas

On the shutting down of the #1 Furnace about the middle of March, this year, we started up the #2 on Mixed Gas with Movable Ports, made by the Blaw-Knox concern, suitable for a 4½″ brick lining inside and outside (the Movable Ports on the #1 Furnace were lined only on the inside). This #2 Furnace to the date of writing this paper, has made a total of 97 Heats on Mixed Gas, showing the following results:

#2 Open Hearth Furnace—First Campaign on Mixed Gas

First 97 Consecutive Heats

(1) Fuel Practice—4,440,520 B.T.U. Per G.T. of Ingots.
(2) Preheat Temperature in Mixed Gas—2,013° F.
(3) Preheat Temperature in Air—1,817° F.
(4) Average Stack Temperature—840° F.
(5) Ratio of Blast Furnace Gas to Coke Oven Gas by Vol.—2.15 to 1.00.
(6) Heats—97.
(7) Ingots—12,357 G.T.
(8) Blast Furnace Gas = 90 B.T.U. Coke Oven Gas = 582 B.T.U. Per Cu. Ft.
(9) Percent of Hot Metal in Charge—44.4%.
(10) Percent of Steel Scrap in Charge—55.6%.
(11) Average Time Per Heat—13:08.
(12) Average Size of Heat—127 G.T.

You will note, thus far on the #2 Furnace, we are 78,000 B.T.U. below the fuel practice on the Movable Port Campaign on #1 Furnace. This, no doubt, is due to maintaining the high Preheat in the Mixed Gas and getting the Preheat in the Air up 150° F., but it is interesting to note that getting the Preheat up in the Air doesn't seem to have nearly the beneficial effect as does the getting up of the Preheat in the Mixed Gas, as shown by a comparison of the Third and Fourth Campaigns of the #1 Furnace, where we increased the Preheat in the Gas 188° F. (from 1,808 to 1,996) and lowered the fuel practice by 471,000 B.T.U. Per Gross Ton. That, of course, in conjunction with fewer stoppages for brick repairs, but by eliminating the high B.T.U. Heats made immediately after each stop for brick repairs in the Third Campaign, gives us an Average Fuel Consumption for the Third Campaign of 4,801,200 B.T.U. (4,801,200 — 4,518,560 = 282,640 B.T.U.), therefore, the Fourth Campaign still shows a reduction of 282,640 B.T.U. Per Gross Ton, which we feel is entirely attributable to the higher Preheat in the Mixed Gas in the Fourth Campaign.

We had been running this #2 Furnace on our ordinary proportions of Hot Metal and Scrap, as shown in the previous campaigns, until about April 23, when it was intimated that we couldn't operate on 60% Hot Metal and 40% Scrap with the necessary Original Ore Charge without excessive foaming and the resulting disastrous effects. Instructions were issued immediately to work up the Furnace gradually to a 60% to 62% Hot Metal Charge and since April 23 it has made 33 Ore Heats with the following results:

#2 Open Hearth Furnace—First Campaign on Mixed Gas

33 Ore Heats

(1) Fuel Practice—4,484,000 B.T.U. Per G.T. of Ingots.
(2) Preheat Temperature in Mixed Gas—2,013° F.
(3) Preheat Temperature in Air—1,848° F.
(4) Average Stack Temperature—890° F.
(5) Ratio of Blast Furnace Gas to Coke Oven Gas by Vol.—2.06 to 1.00.
(6) Heats—33.
(7) Ingots—4,105 G.T.
(8) Blast Furnace Gas = 90 B.T.U. Coke Oven Gas = 582 B.T.U. Per Cu. Ft.

(9) Percent of Hot Metal in Charge—61.5%.
(10) Percent of Steel Scrap in Charge—38.5%.
(11) Average Amount of Ore in Original Charge—34,100 lbs.
(12) Average Time Per Heat—12:19.
(13) Average Size of Heat—124 G.T.

Our Melter Foremen who have had experience with the operation of Gas Producer Open Hearth Furnaces on Ore Heats claim that this Furnace on Mixed Gas worked just as satisfactorily on Ore Heats as any Gas Producer Furnace.

It has been thought by some also that we would be in trouble with foaming if we had an Ore Heat melt **high.** Our experience has been quite to the contrary as indicated by the following Heats made within the last two or three weeks:

ORE HEATS THAT MELTED HIGH

Heat No.	Grade	Ore Lbs.	Ore %	Scrap Lbs.	Scrap %	Hot Metal Lbs.	Hot Metal %	Melt Carbon	Condition of Slag When Melted	Lump Ore Used to Reduce Carbon	Time of Heat	B.T.U. Per Ton
23,765	20/30	9,300	1.35	158,000	54.65	127,000	44.00	.90	Hvy. Mushy Limy	9,000	10:15	4,070,000
23,767	15/20	20,200	2.60	134,900	44.10	163,400	53.30	1.02	Hvy. Mushy Limy	9,000	9:30	4,505,000
23,769	17/22	25,800	3.61	128,720	42.55	162,000	53.84	.90	Very Hvy. Slag	10,000	11:10	4,525,000
23,770	5/12	30,100	4.18	131,300	43.22	159,500	52.60	1.00	Hvy. Mushy Limy	12,000	11:00	4,610,000
23,779	16/21	30,100	4.36	113,250	38.89	165,200	56.75	.60	Hvy. Mushy Limy	4,000	11:20	4,505,000
23,793	15/25	36,600	6.00	92,800	31.85	181,000	62.15	.75	Hvy. Mushy Limy	6,000	11:05	4,395,000
23,798	20/30	43,000	7.50	86,670	29.61	190,600	62.89	1.00	Hvy. Mushy Limy	10,000	12:10	4,410,000
23,800	35/40	44,900	7.29	96,550	29.63	205,600	63.08	.90	Very Hvy. Mushy Limy	7,000	11:55	4,225,000
23,803	35/40	44,800	7.52	84,140	26.72	207,100	65.76	.70	Hvy. Mushy Limy	6,000	11:05	4,185,000

You will note from this statement that we have had quite a few Heats melt as high as .90% and 1.00% Carbon and they have been finished up in the average time of other Heats and with about the same average B.T.U. consumption. It has been found that in every Heat, no matter how high it melted, a heavy, mushy, active slag covered the Heat when melted. This is not in accordance with the usual experience on Oil or Producer Gas-Fired Furnaces, where a raw, hard, inert slag is not uncommon when the bath melts high.

In Conclusion

We feel that by the use of this Movable Port we have surmounted the difficulties inherent in the use of Mixed Gas as set forth by the following quotations from an article by Dr. Bansen on "The Influence of the Preheating of Gas and Air on the Behaviour of the Open Hearth Furnace":

> "Summing up, a low gas preheating causes, first, a lowering of the efficiency on account of the lower winning back of the heat in waste gasses leaving the hearth, and, second, poorer heat transfer in the Furnace Proper, i.e., over the Bath. This latter disadvantage shows up accordingly in a higher temperature of the waste gases leaving the space above the hearth and consequently in a higher temperature of waste gases at the outlet of the air regenerators, the latter higher temperature of waste gases being due to the small gas port exit which caused the low preheating of gas. This state exists until the equilibrium has been established."
>
> "The gas regenerators, in most cases, get the worst of it by not receiving sufficient waste gases."
>
> "The preheat is of utmost importance for the furnace working thermally correct. In addition to the high recovery of the waste heat which determines the thermal efficiency of the furnace, the preheat of the gas, particularly that of a mixture of blast furnace and coke oven gas, influences greatly the heat transfer in the combustion space above the hearth. The efficiency of the furnace can be watched and governed very simply by the losses in the waste gases. The preheating and efficiency are determined by the distribution of waste gases in the air and gas regenerators and the proper distribution can be determined correctly from the waste gas temperatures and the draft measurements."

We, therefore, feel, as stated in the beginning of this paper, that we have developed a prototype of Open Hearth Furnace and Open Hearth Practice that will operate on Mixed Gas quite satisfactorily and efficiently, making any grade of steel and using any kind of a charge that can be handled by a Producer Gas or Oil-Fired Furnace. We feel also that the Movable Port would be of great advantage on Gas Producer Furnaces in saving brick repairs and in maintaining a constant jet velocity of the burning gas due to the Port maintaining its size and shape from beginning to end of the campaign.

Second Annual

ELECTRIC HEATING AND WELDING CONFERENCE

November 12th and 13th, 1930

AUSPICES OF A. I. & S. E. E.,

PITTSBURGH, PA.

(Continued from Page 393

affairs of today. We should all endeavor to continue to contribute our thoughts and our ideas in connection with our practical and routine problems which exist in our industry today. The IRON AND STEEL ENGINEER is your periodical, it represents your profession, it is your spokesman, and you should feel at all times that you are at liberty and privileged to contribute to the editorial columns.

Iron and Steel Exposition

The IRON AND STEEL EXPOSITION, which is being held in conjunction with our CONVENTION, is one of the greatest efforts in the history of our Association. You should make it a special point to visit this EXPOSITION as many times as possible. You will not be disappointed. All of the developments during the past year will be on exhibit. The manufacturers, who serve our industry so faithfully, have labored very hard to make the EXPOSITION one of the greatest educational institutions in this country today; to make this complete, it requires your presence. I want to take this opportunity of publicly acknowledging the Steel Industry's gratitude to all of these manufacturers who have so splendidly co-operated with us.

Election of Officers

The tellers who are appointed to canvass the ballots cast for the election of officers for the ensuing year, have reported as follows:

President ..... R. M. Hussey
First Vice President ..... F. O. Schnure
Second Vice President ..... J. J. Booth
Treasurer ..... James Farrington
Secretary ..... W. E. Miller
Director at Large ..... F. D. Egan
Directors—F. W. Acker, N. C. Bye, E. C. Winfield, J. H. Van Campen, Wray Dudley, W. N. Flanagan, J. A. Voss.

Items of Interest

PERSONNEL CHANGES

G. REES CARROLL

G. Rees Carroll has been appointed Electrical Superintendent at the Aliquippa Works of the Jones & Laughlin Steel Corporation to succeed R. M. Hussey, who has been made superintendent of the Rod and Wire Department at the same works.

Following his graduation from the Carnegie Institute of Technology, Mr. Carroll spent two years with the Bell Telephone Company in Pittsburgh, and in 1917 became connected with Wm. B. Scaife & Sons, of Pittsburgh, supervising their erection work in the various steel mills in the Pittsburgh district. Eight years ago he became associated with the Jones & Laughlin Steel Corporation in the capacity of Assistant Electrical Superintendent at the Aliquippa Works and has held this position up to the time of his recent advancement to the position formerly held by Mr. Hussey. Mr. Carroll is an active member of the A. I. & S. E. E., and the membership of the Association are extending their congratulations.

Geo. A. Kaufman, formerly Assistant Electrical Engineer of the Jones & Laughlin Steel Corporation of Aliquippa, Pa., has been promoted to Electrical Engineer of the Corporation with offices in Pittsburgh. Mr. Kaufman is an active member of the A. I. & S. E. E., and the Association extend their best wishes for his success in his new position.

R. M. HUSSEY

R. M. Hussey, formerly Electrical Superintendent of the Jones & Laughlin Steel Corporation of Aliquippa, Pa., has been promoted to Superintendent of the Rod and Wire Mills at the Aliquippa plant. Mr. Hussey is an active member of the Association of Iron and Steel Electrical Engineers and the Association membership and his many friends wish him success in his new connection.

R. S. Coulter, who for the past eleven years has been Combustion Engineer for the Sparrow's Point Plant of the Bethlehem Steel Company, has resigned his position in favor of his private practice of Consulting Combustion Engineering. His headquarters will be in Lebanon, Pa.

Electric Service Supplies Company announces the appointment of C. H. Harshaw to the sales department of their Pittsburgh office.

Blaw-Knox Company announces the addition to its sales staff of John E. Chiquoine. Mr. Chiquoine will develop an extensive line of welded and other Blaw-Knox process equipment for the chemical and process industries.

J. B. Gillham and G. A. Anderson of the Reliance Electric & Engineering Company, Cleveland, O., have been sent to the Los Angeles and San Francisco offices respectively of the Utilities Equipment Corporation where they will handle the sales of Reliance alternating current and direct current motors.

The Utilities Equipment Corporation are sales and service representatives for the Reliance Company on the Pacific Coast.

The Keystone Lubricating Company of Philadelphia, Pa., announce the appointment of H. W. Allen to the sales department of the Pittsburgh office. Mr. Allen will have charge of the Central Pennsylvania territory.

Charles D. McCall has joined the staff of Manning, Maxwell & Moore, Inc., and has been appointed in charge of sales of Putnam Machine Tools in Detroit territory with headquarters in the General Motors Building.

The Ohio Electric Mfg. Co., Cleveland, O., wish to announce the appointment of R. W. Carlisle, Indiana Pythian Building, Indianapolis, Ind., as their factory representative in the sale of their complete line of Fractional Horsepower Motors.

J. L. Van Nort has been advanced to sales engineer of the Boston office of the Reliance Electric & Engineering Company, Cleveland, manufacturers of alternating and direct current motors.

Effective May 1 Frank Dustan of the engineering department of Putnam Machine Works, Fitchburg, Mass., was appointed chief engineer of this important plant of Manning, Maxwell & Moore, Inc.

In 1919 Mr. Dustan joined Manning, Maxwell & Moore, Inc., organization as a designer and later held positions of assistant chief draftsman and sales engineer, specializing in railroad and steel mill machinery.

H. S. Schroeder has been appointed western manager of sales for the Republic Steel Corporation, with headquarters in Chicago, it was announced by H. T. Gilbert, vice president in charge of sales of the corporation. Mr. Schroeder formerly was vice president and general sales manager of the Interstate Iron & Steel Company, Chicago.

E. A. Clark, sales engineer of the Philadelphia office of the Reliance Electric & Engineering Company, has been advanced to the engineering department in Cleveland where he will be engaged in the design of direct current motors.

Mr. A. L. Foell, formerly Chief Engineer of the Donner Steel Company of Buffalo, N. Y., has accepted a position as Chief Engineer of the Arthur G. McKee Company of Cleveland, Ohio. Mr. Foell is a very active member of the A. I. & S. E. E., serving on the Gas Producer Section Committee of the Combustion Engineering Division of the Association. The Association and his many friends are wishing him the best of success in his new position.

Mr. W. J. Harper, formerly Fuel Engineer of the Donner Steel Company of Buffalo, N. Y., has been promoted to the position of Chief Engineer succeeding Mr. Foell. Mr. Harper is extremely active in A. I. & S. E. E. affairs and is also serving on the Gas Producer Section Committee of the Combustion Engineering Division of the Association. The Association membership and his hosts of friends are extending their best wishes.

POSITION WANTED

A man who has had vast experience in steel mill electrical repair work is now open for employment in the capacity of foreman in charge of electrical repairs. He would be willing to start in a subordinate position and is not particular as to the location of plant. His experience ranges from helper in armature repair shop to foreman in charge of all electrical repairs, coil winders, etc. This experience gained in one of the largest steel plants in the country. This man would make a valuable addition to any electrical department personnel. His services are available at once. Write Box A, Iron and Steel Engineer.

WITH THE MANUFACTURERS

Announcement is made by Cutler-Hammer, Inc., Milwaukee, Wis., that on July 1, they acquired all common stock of Schweitzer & Conrad, Inc., Chicago, manufacturers of high voltage equipment.

Schweitzer & Conrad will continue to operate as an independent manufacturing and selling unit. No changes in organization or personnel will be made except Beverly L. Worden, president of Cutler-Hammer, has also been elected president of Schweitzer & Conrad.

National Carbon Company of Cleveland are distributing a new booklet entitled "Behind the Pyramids." The booklet deals with the manufacture of Carbon Brushes and interested parties may obtain copy on request.

The Hodson Corporation of Chicago, Ill., have prepared an attractive booklet on their lubricating systems. The booklet is well illustrated showing

installations and piping diagrams, etc. Copies will be sent on request.

"The Weld-Built Motor" is the title of Bulletin 262 which the Electro Dynamic Company of Bayonne, N. J., are distributing. Copy of the bulletin may be obtained on request.

The Leeds & Northrup Company of Philadelphia have prepared an attractive and well illustrated 32-page bulletin on "Metered Combustion Control." The bulletin will be supplied on request.

"More Load Per Consumer" is the title of a very interesting booklet which has just been prepared by the Sangamo Electric Company of Springfield, Ill. Copy will be mailed on request.

The Edwin L. Wiegand Company of Pittsburgh, Pa., announce that the winner of the Thomas A. Edison Siphonator, which they gave away during the convention at Buffalo, N. Y., June 16 to 20, was L. W. Lamson, power engineer of American Brass Company of Buffalo, N. Y.

The G. & W. Electric Specialty Company of Chicago, Ill., announce that their latest catalog No. 30 is now ready for distribution. Steel mill and central station men and others interested in distribution specialties are invited to write for this new catalog.

The Roller Smith Company of New York, N. Y., announce a new instrument, the Type BME No. 6 Dry Cell Tester. This tester is described in detail in Supplement No. 2 to Bulletin No. 210. Copies may be had on request.

The George D. Whitcomb Company of Rochelle, Ill., have prepared a very attractive folder on a Whitcomb 80-Ton Oil-Electric Switching Locomotive. The folder may be obtained by writing the above company.

A new folder on the Crocker Wheeler Speed Changer is now ready for distribution. The folder illustrates several installations of the speed changer and copy may be had by writing the Crocker-Wheeler Company, Ampere, N. J.

Bulletin No. 10 just issued by Rockbestos Products Corporation, New Haven, Conn., gives construction specifications and applications of Rockbestos insulated wires and cables for use in power companies and industrial plants wherever wiring is exposed to heat, moisture, fumes, acids, vapors, oil or grease. Copies sent on request.

The Delta-Star Electric Company, Chicago, Ill., are distributing Bulletin 38-CD describing their solderless compression type terminal lugs for use on switches, transformers, oil circuit breakers and other points where solderless type lugs are necessary.

Electric Machinery Manufacturing Company announces that after the first of April, their Chicago office will have a new location. The new office will be in Room 1567, 20 North Wacker Drive Building.

William Swindell & Bros., manufacturers of a complete line of combustion and electric furnaces for ferrous and non-ferrous melting, heat treating, annealing, etc., have become a part of Swindell-Dressler Corporation with offices and plant at Pittsburgh, Pa.

Announcement has been made by the Fuller Lehigh Company, manufacturers of pulverized-coal firing equipment and Bailey Water-Cooled Furnace Walls, of the opening of a new sales office in the Candler Building at Atlanta, Ga. J. Mc. C. Hill is in charge of the new office. The main offices and works of Fuller Lehigh Company are located at Fullerton, Pa.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS' INSPECTION TRIP AT WESTINGHOUSE ELECTRIC & MFG. COMPANY'S PLANT AT EAST PITTSBURGH, PA.

"ARC WELDING"

About 150 members of the A. I. & S. E. E. attended the inspection trip to the Westinghouse Electric and Manufacturing Company's plant at East Pittsburgh, Pa., June 30, 1930.

This trip was principally in connection with arc welding and its many ramifications.

The Steel Industry has its place in the development of this type of welding, much more so, than any electrical manufacturing concern, since arc welding has opened up many new uses for steel.

Three electrical concerns alone use approximately 3500 tons of rolled steel each month, in place of castings.

Take welding wire alone, at least $1,000,000 worth of wire used annually with prices ranging from 40 cents per pound to $3 per pound.

The time is at hand when the Iron and Steel Industry should evince more than a passive interest in an art that means handsome returns, for the investment incurred.

What really may be accomplished with arc welding was exemplified in a most practical manner by the Westinghouse Electric and Manufacturing Company in the following:

An eleven-story structure, containing 2000 tons of steel, the largest, tallest, all-welded structure, erected so far.

An all-welded parking garage, containing 200 tons of steel.

A tank shop, all-welded, containing 350 tons of steel.

A rolling mill, where large slabs of steel are rolled and formed for use as frames on large rolling mill motors. (Forms are arc welded).

A fabrication department with eighty seasoned operators, who arc weld daily, forming steel parts for electrical apparatus.

A machine tool department, where many jig and machine tool structures are made from standard steel shapes with the use of arc welding.

Arc welding in the next few years will make obsolete what is considered to be modern steel mill equipment today, and it behooves the Steel Industry as a whole, to awaken to this fact and embrace it.

Announcement

1931 Annual Convention and Iron & Steel Exposition

Will Be Held At

CLEVELAND, OHIO
JUNE 15th-16th-17th-18th-19th, 1931

Convention Headquarters
Hotel Statler

Iron and Steel Exposition
Cleveland Public Auditorium

Reservations For Space Being Accepted

Address

ASSOCIATION OF IRON & STEEL ELECTRICAL ENGINEERS
1010 EMPIRE BUILDING **PITTSBURGH, PA.**